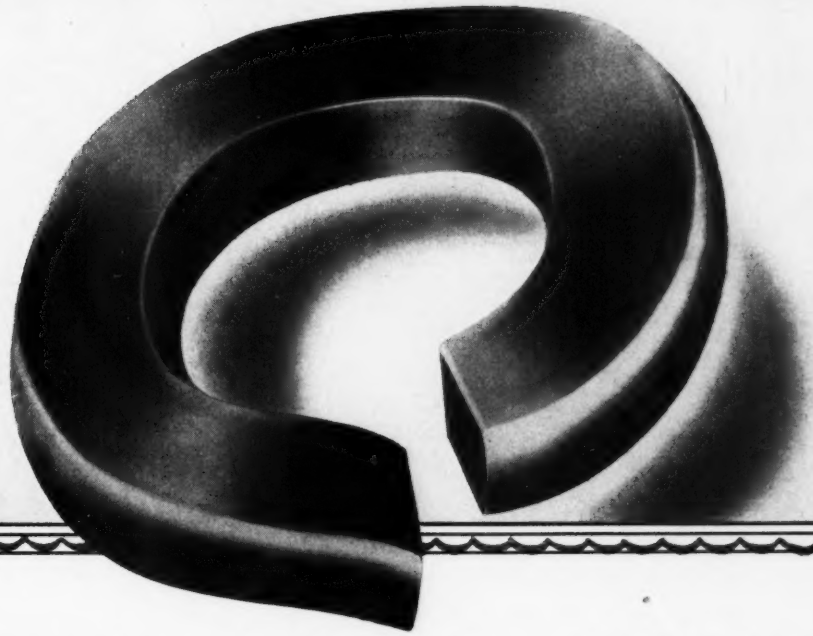
Railway Engineering and Maintenance

LEADERSHIP



OVER twenty years ago we advocated to the railroads of this country the adoption of a drastic new theory pertaining to the proper functioning of spring washers, then termed nut locks. The immediate response was none too encouraging.

Six years ago we placed upon the market IMPROVED HIPOWER -- a device incorporating the principles necessary to the successful application of our theory.

Today our original theory is accepted as official by practically every railway executive—its essentials have been embodied in every railroad and association specification.

In over twenty years our fundamental principles of spring washer efficiency have never varied. The adoption of IMPROVED HIPOWER by the bulk of America's railroads has revolutionized the entire industry.

THE NATIONAL LOCK WASHER COMPANY, *Newark, N. J., U.S.A.*

IMPROVED HIPOWER

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Railway Engineering and Maintenance

Formerly the Railway Maintenance Engineer

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Reaching the high state of perfection in Fairmont products would have been impossible without the heartiest co-operation of the railroads' employees in all departments. Working shoulder to shoulder for the good of the industry, Fairmont engineers have succeeded in building into the cars the many practical suggestions offered to date. The qualities of "Performance on the Job" exclusive to Fairmont railway motor cars are responsible for the invariable replacement of other cars with Fairmonts.

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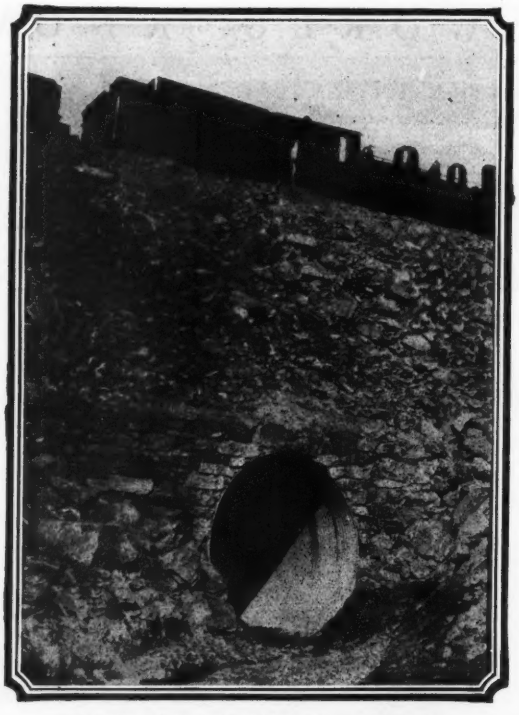

Flexibility helps this 96-inch Armco Culvert under a Western railroad resist the pressures of a 32-foot rock fill and heavy traffic. Exhaustive tests amply confirmed by field experience, show that the unsurpassed safety of the corrugated pipe is due to its flexible feature.

A *safe* large culvert with ARMCO *flexible* design

UNYIELDING culverts that attempt to resist the tremendous thrusts developed by fill and traffic, are subjected to crushing strains.

Leading authorities are agreed on this point. Exhaustive tests at Iowa State College, at the University of North Carolina and by the American Railway Engineering Association show conclusively that—

(1) The vertical pressure from weight of fill on rigid type culverts is practically 3 times the vertical pressure on flexible pipe.

(2) Supporting pressures against the horizontal axis of flexible pipe culverts are approximately four times as great as on rigid culverts.

In a sentence, flexibility distributes the crushing pressures from above and builds up supporting pressures from the sides, giving unit stresses that are easily resisted by the Armco corrugated design.

The larger the culvert the more important the *safety* of flexibility. It will pay you particularly to investigate the preproved strength of Armco Culverts in diameters from 2 to 9 feet. Write today for our bulletin "Basing Confidence in Culvert Strength on Engineering Facts."

ARMCO CULVERT MANUFACTURERS' ASSOCIATION
MIDDLETOWN, OHIO

ARMCO CULVERTS

Predominant in use—because predominant in quality

©1928, Armco Culvert Mfrs. Assn., Middletown, Ohio

You can't do this with a track shovel!

—nor with horses and scrapers either!

One large railroad that owns five Northwests saved from $35,000 to $40,000 on ditching alone last year.

The Northwest arrives at a job completely erected; is unloaded under its own power in a short time and gets to work without delay. Enough fuel for several days can be lashed to the back—no steam troubles, no water troubles, no coal troubles, and no horses to tend at night.

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The world's largest exclusive builders of gasoline, electric and diesel powered shovels, cranes and draglines.

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Chicago, Ill., U. S. A.

Here is the way to dig lead-off ditches—off the car, the job finished, on to another in jig time.

NORTHWEST
CRAWLER WITH CONVERTIBLE CRANE
Gasoline-Diesel-Electric

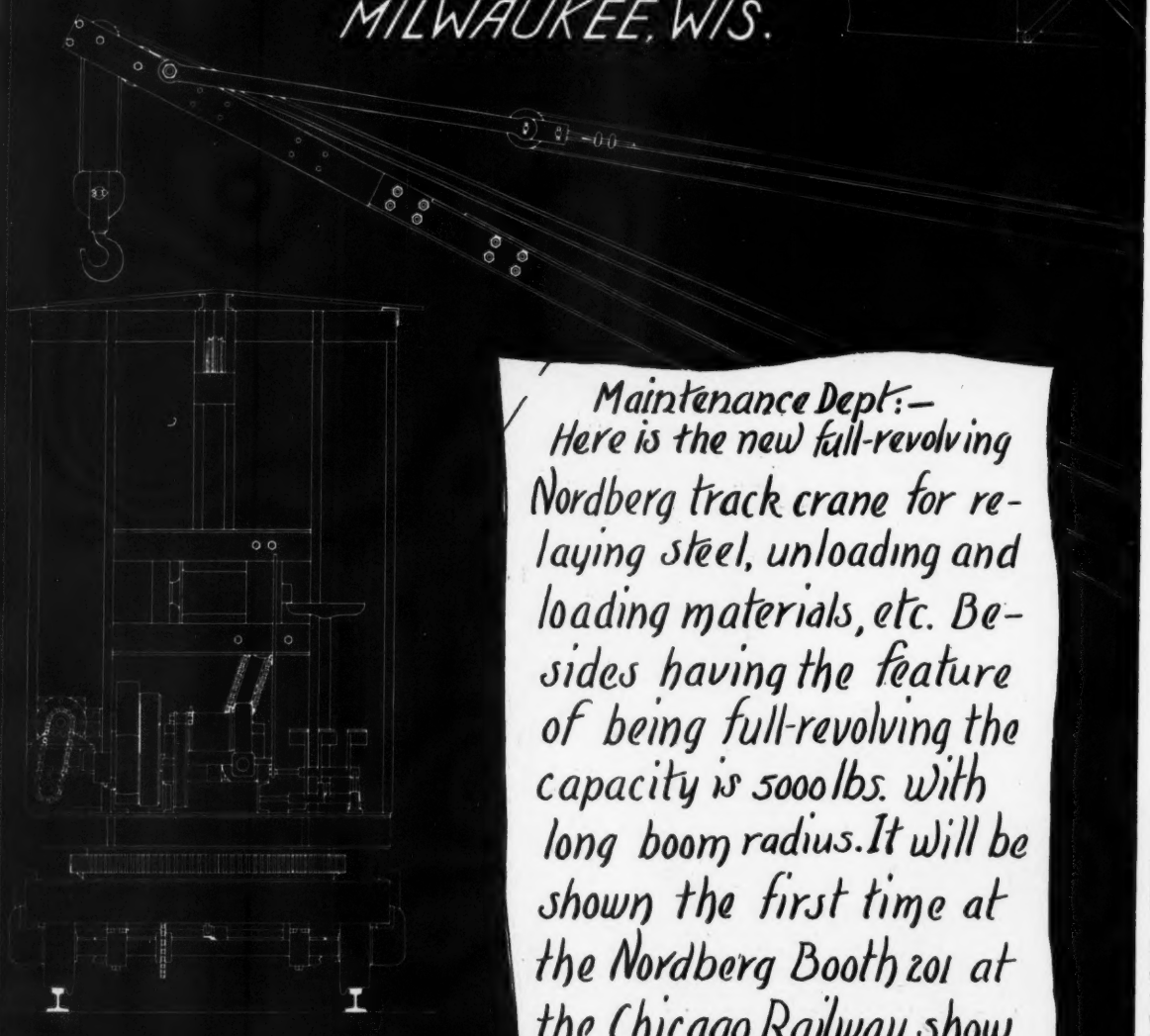
REM2-Gray

Full Revolving TRACKRANE and Rail Layer

Built By

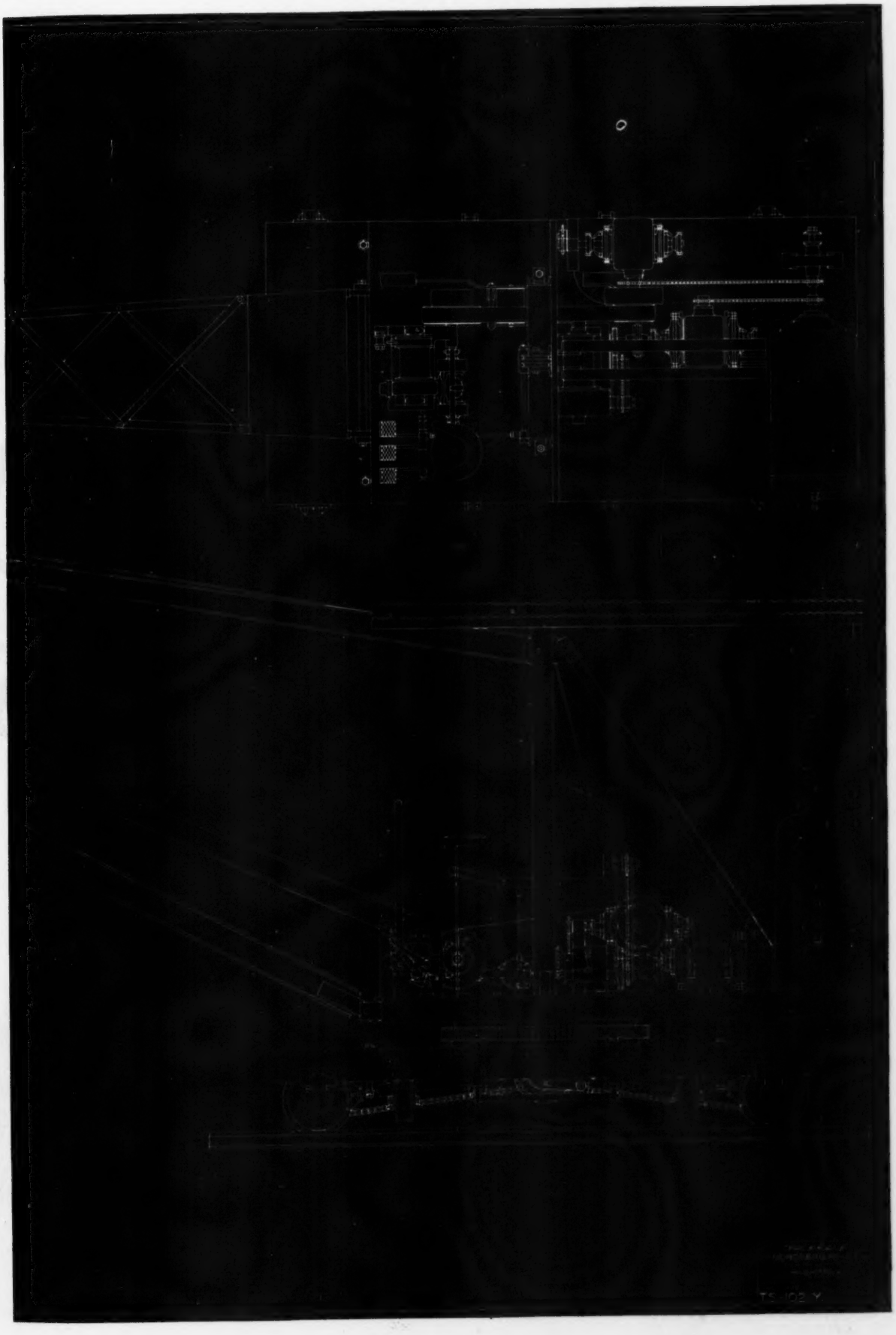
NORDBERG MFG. CO.

MILWAUKEE, WIS.

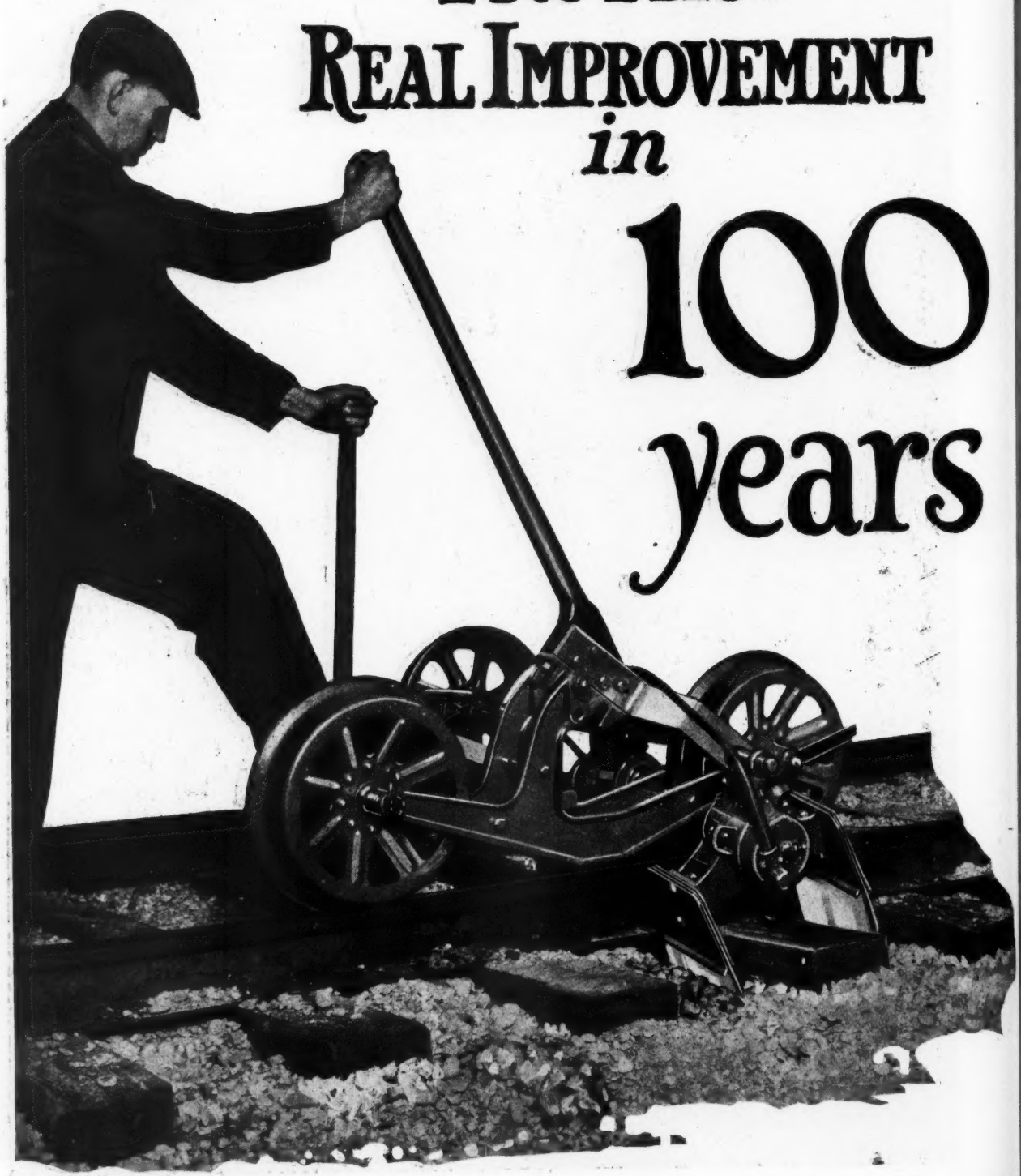


Maintenance Dept:—
Here is the new full-revolving Nordberg track crane for relaying steel, unloading and loading materials, etc. Besides having the feature of being full-revolving the capacity is 5000 lbs. with long boom radius. It will be shown the first time at the Nordberg Booth 201 at the Chicago Railway show March 5-11. Be sure to see it.

Bill



Announcing The First REAL IMPROVEMENT in 100 years



THE JACKSON

HI-SPEED GRAVEL TAMPER

for

GRAVEL-CINDERS AND ALL LIGHT BALLAST

For the past 100 years no means of tamping gravel and the lighter ballast has proven so successful as the shovel.

No mechanical appliance has been developed that would perform this work with the same speed or with as low a cost as this old original method.

The Jackson Hi-Speed Gravel Tamper, the result of years of study and development, far excels any existing method known for speed and quality of work.

More track can be perfectly and uniformly tamped in a few hours with the machine than an average gang can tamp in a day, resulting in a saving in cost that will more than pay for the original outlay during a season.

Illustrating simultaneous tamping action on each side and under the tie.

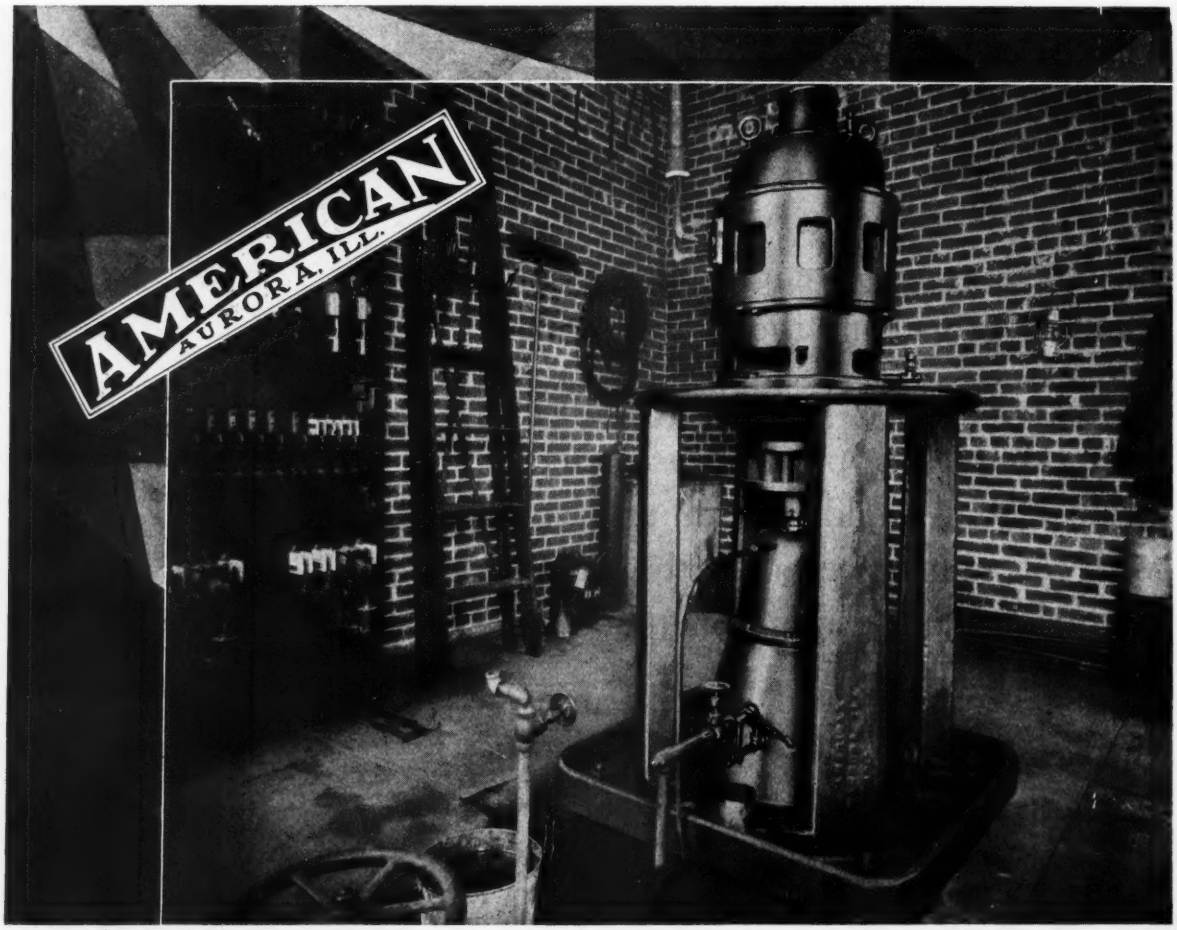
Oscillation of machine insures tight tamping and fresh supply of ballast under both sides of tie.

When in Chicago drop in and let us give you a demonstration, as we will maintain an exhibit on this outstanding labor saving equipment until March 15.

If you have not received our circular describing this appliance in full, send for your copy NOW!

ELECTRIC TAMPER & EQUIPMENT CO.

RAILWAY EXCHANGE BLDG. CHICAGO, ILLINOIS



An "American" Turbine on the C. & E. I.

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AN "AMERICAN" 15-inch, three stage, deep-well turbine was installed for the C. & E. I. Railroad Company at Clinton, Ind.

This "American" turbine in the Jackson Yard is designed to have a capacity of 500 G. P. M. against a total head of 110 feet when running at 1165 R. P. M.

The pump is operated by a vertical motor and the equipment is used for serving the water tanks in the Yard.

The "American" trade mark, with its guarantee of satisfactory performance, may be found on the pump equipment of many of the leading railroads of the country.

THE AMERICAN WELL WORKS

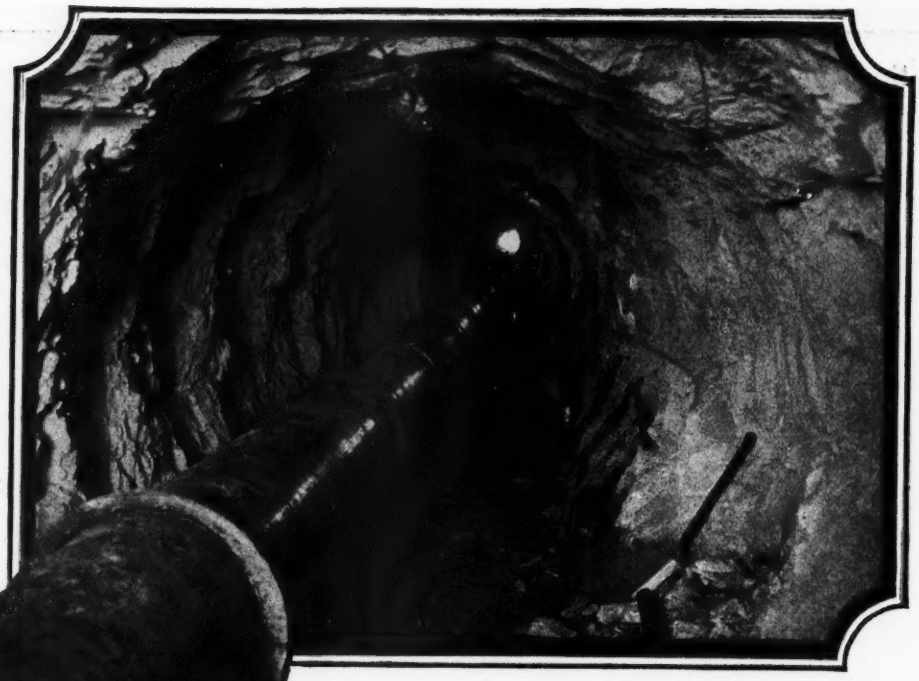
General Offices AURORA, ILLINOIS *and Factory*

A ROADMASTER SAYS—

"I particularly favor the FAIR Rail Anti-Creeper, largely because it is so rugged, is one-piece, and applies much more quickly than any other Rail Anti-Creeper; furthermore, no tool is required excepting a spike maul and it is easy to take off when renewing ties and can be quickly reapplied. These advantages cannot be claimed by the other types of Rail Anti-Creepers which I have used."

CHICAGO THE P. & M. CO. NEW YORK

MONTREAL LONDON PARIS CALCUTTA SYDNEY



PHOTOGRAPH showing part of a cast iron pipe installation at Chicago, Illinois.

Standard Bell and Spigot can be laid easily

even under the most unusual conditions

THE cast iron pipe illustrated here passes through an *unlined* rock tunnel.

The strength of Cast Iron Pipe makes this type of installation possible. The accessibility of lines laid in this manner will be quickly appreciated by engineers.

Contractors have long been aware of the ease of standard Cast Iron Pipe installations and can make their bids accordingly.

We maintain a special Service Department for the assistance of contractors and construction engineers. Information about it will be sent to you gladly—write for details, there is no obligation involved.

UNITED STATES CAST IRON PIPE & FOUNDRY CO.
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Cast Iron Pipe
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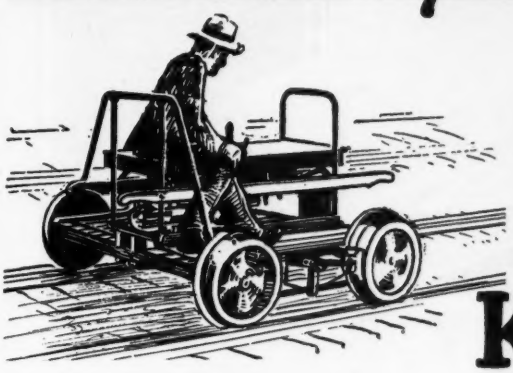
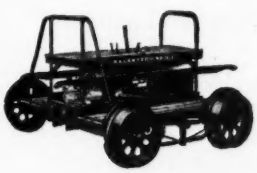


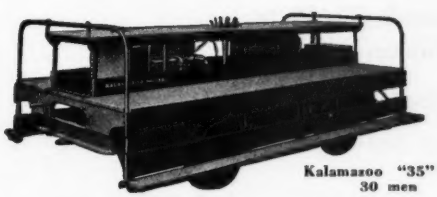
Whether Its
One Man to Go One Mile
—or—
30 Men to Go 30 Miles
KALAMAZOO

will get them there more economically and more comfortably—

that is why KALAMAZOO hand and motor cars are appreciated by all railroad men. There's a type for every railroad requirement.



Kalamazoo "16L" for one or two men



Kalamazoo "35" for 30 men

Kalamazoo "23" for 8 or 10 men

KALAMAZOO RAILWAY SUPPLY CO.

Established 1884

Kalamazoo, Mich.

New York	Chicago
St. Louis	St. Paul
New Orleans	Denver
Spokane	Seattle
Portland, Ore.	Havana
London	Mexico City
Johannesburg	Vancouver
Winnipeg	Montreal

Another Example

Of How Thoroughly LUNDIE TIE PLATES Protect Ties

Note:

(1) —The uniform seating and smooth surface of the ties under Lundie Tie Plates after several years of very heavy traffic.

(2) —Absolutely no cutting into the ties due to the absence of any destructive ribs.

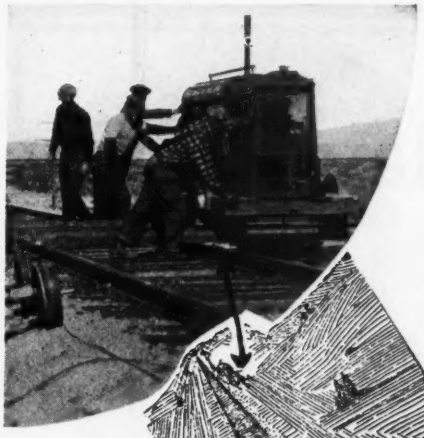
(3) —No movement of plates on the ties showing track has been held to rigid gauge.

(4) —The checks in the ties have stopped where the Lundie Tie Plates were seated on the ties.

This is but another example of how thoroughly Lundie Tie Plates protect the ties assuring maximum tie life at a minimum of expense.

The Lundie Engineering Corporation
285 Madison Avenue, New York
166 West Jackson Boulevard, Chicago

LUNDIE TIE PLATE



Rebuild Your Rail Ends Electrically

by the

Teleweld Process

"A MILE AT A TIME"

NOT an Experiment! Four Years Under Main Line Traffic

175,000 joints in service on 4 Transcontinental Railroads

The Teleweld equipment is self-propelled and flexible. It moves rapidly over the rails with no interference to train operation, and is set off in the clear of traffic while operating.

By extending operations over a half-mile of track each way from each set-off, the work is completed "A Mile at a Time."

As **no pre-heating** is necessary, the heat being localized, instant fusion of a specially processed metal with the rail end is accomplished by the Teleweld process.

Efficient high speed **grinding machines** served from the power plant produce a perfectly level surface the full length of the joint bar.

A new plan of rail maintenance is offered—definitely priced—responsibility fixed—workmanship guaranteed.

Our representative will call and explain in detail.

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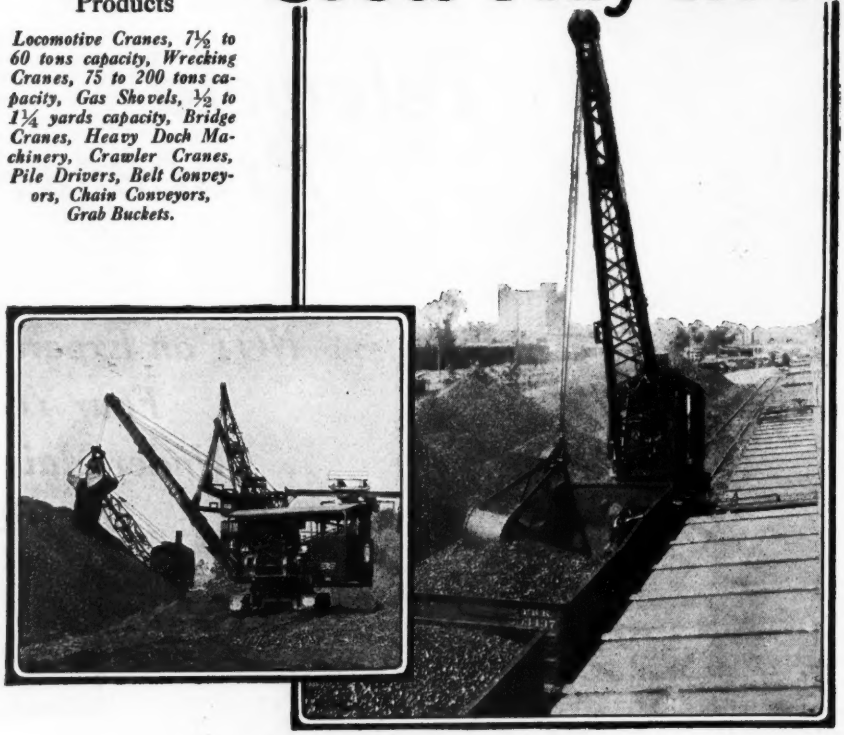
Chicago Railway Exchange Bldg.
Salt Lake City Continental Bank Bldg.
Denver 2101 Blake Street

Do Your Handling Costs Play Hookey?

Products

Locomotive Cranes, 7½ to 60 tons capacity, Wrecking Cranes, 75 to 200 tons capacity, Gas Shovels, ½ to 1¼ yards capacity, Bridge Cranes, Heavy Doch Machinery, Crawler Cranes, Pile Drivers, Belt Conveyors, Chain Conveyors, Grab Buckets.



Handling costs, like school boys, often get beyond control and are lost sight of in the bigger scheme of a large manufacturing schedule. Yet authorities say that handling is one of the most costly parts of production and one place where big economies may still be effected.

For handling material in the yard, unloading of castings, bars and scrap, stocking of coal, loading of finished product and a score of other uses, no equipment will equal a locomotive crane in speed or operating economy.

If there is any doubt in your mind as to where you stand on handling costs get in touch with one of our representatives. He has been of service to many companies with problems identical with your own. And you can rely on his recommendations because of the universal satisfaction Industrial Brownhoist equipment has given for half a century.

Industrial Brownhoist Corporation

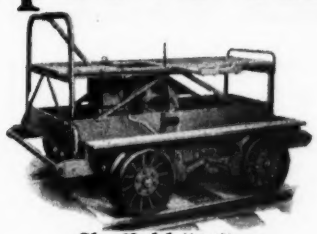
General Offices: Cleveland, Ohio.

District Offices: New York, Philadelphia, Pittsburgh, Detroit, Chicago, St. Louis, San Francisco, New Orleans, Bay City, Mich.

INDUSTRIAL BROWNHOIST

Sheffield "40-B"
Foremost in everything a fine section car should be

The rails of a continent prove Sheffield's leadership



Sheffield "44"
A one-cylinder water-cooled car of universal utility, equipped with positive chain drive and smooth-acting, foolproof clutch that cannot be burned out.

Sheffield "41"
The most popular centerload light inspection car on the market. Has a simple, easy-starting, two-cylinder air-cooled engine.

FOR over thirty years Sheffield Motor Cars have been thoroughly inspected and tested in the factory and then have gone out to prove their leadership on the greatest of all "proving grounds"—the rails of a continent.

And in Sheffield Cars of today you see the result. Improvement after improvement has been incorporated in these sturdy, dependable motor cars, with the result that the history of section motor car development is virtually Sheffield history.

Sheffield Cars were the first to lead the way with such modern developments as the centerload car, three-point suspension of engine, positive chain drives, Ricardo cylinder head, automobile-type pressed-steel frames, Sheffield pressed-steel wheels with ground tread, Timken Tapered Roller Bearings—and other advanced features.

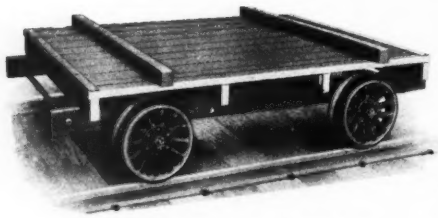
Sheffield has set and maintained the pace of leadership from the beginning in order to give the user the dividends of such leadership—in the form of extra quality, extra features of modern design, extra years of service and satisfaction.

FAIRBANKS-MORSE
MOTOR CARS

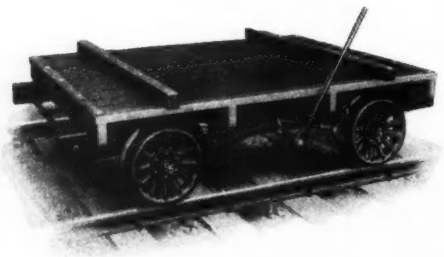
First on the rails — and still first

TIMKEN BEARING EQUIPPED

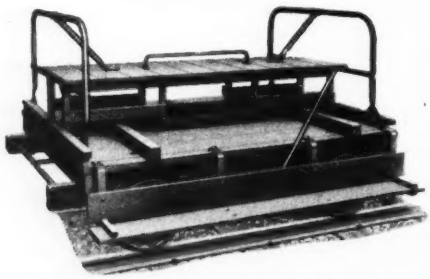
If they were all built like Sheffields—



Stripped push car. Dump sills on deck facilitate unloading and transmit heavy loads directly to bearings without strains on frames



Trailer equipped with sturdy, powerful four-wheel brakes and safety coupler



Trailer completely equipped with rigidly built, removable seat top section, side steps, brakes, Sheffield pressed-steel ground tread wheels and Timken Tapered Roller Bearings

There would be no need to weigh values—if all push cars and trailers were built like Sheffields. But it is because Sheffield push cars and trailers embody the same advanced engineering that goes into Sheffield motor cars—and are built to do the work right—that in the long run they represent by far the best "buy."

And the extra quality in Sheffields is easily recognized. All Sheffields are equipped with Timken Tapered Roller Bearings—the first push cars and trailers to use this advanced type of bearing. Double Timken Bearings are mounted in dustproof boxes, conveniently oiled through holes in the deck which communicate with oil tubes reaching to the axle boxes.

Other features of advanced design are improved adjustable toggle brakes with greatly increased braking power and the use of two bronze-bushed loose wheels to facilitate handling.

Wheels are the 16-inch pressed steel type with ground treads—the same type as used on Sheffield motor cars. The sturdy frames are of selected hard maple, with sills gained into each other and securely bolted.

The improved, sturdier, more durable, yet light-weight construction of Sheffield push cars and trailers allows greater load carrying capacity—6,000 pounds for the "4-B" and 10,000 pounds for the "12-B," with the same liberal factor of safety that formerly applied to the 4,000 and 8,000 pound ratings.

A special F-M bulletin fully describes the Sheffield push cars and trailers, the different equipments with which they are furnished, etc. Send for your copy today.

FAIRBANKS, MORSE & CO., *Chicago*

Manufacturers of railway motor cars; hand cars; push cars; velocipedes; standpipes for water and oil; tank fixtures; oil engines; steam, power and centrifugal pumps; scales; complete coaling stations.

FAIRBANKS-MORSE

PUSH CARS *and* TRAILERS

TIMKEN BEARING EQUIPPED

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New and Improved!

Casey Jones 581

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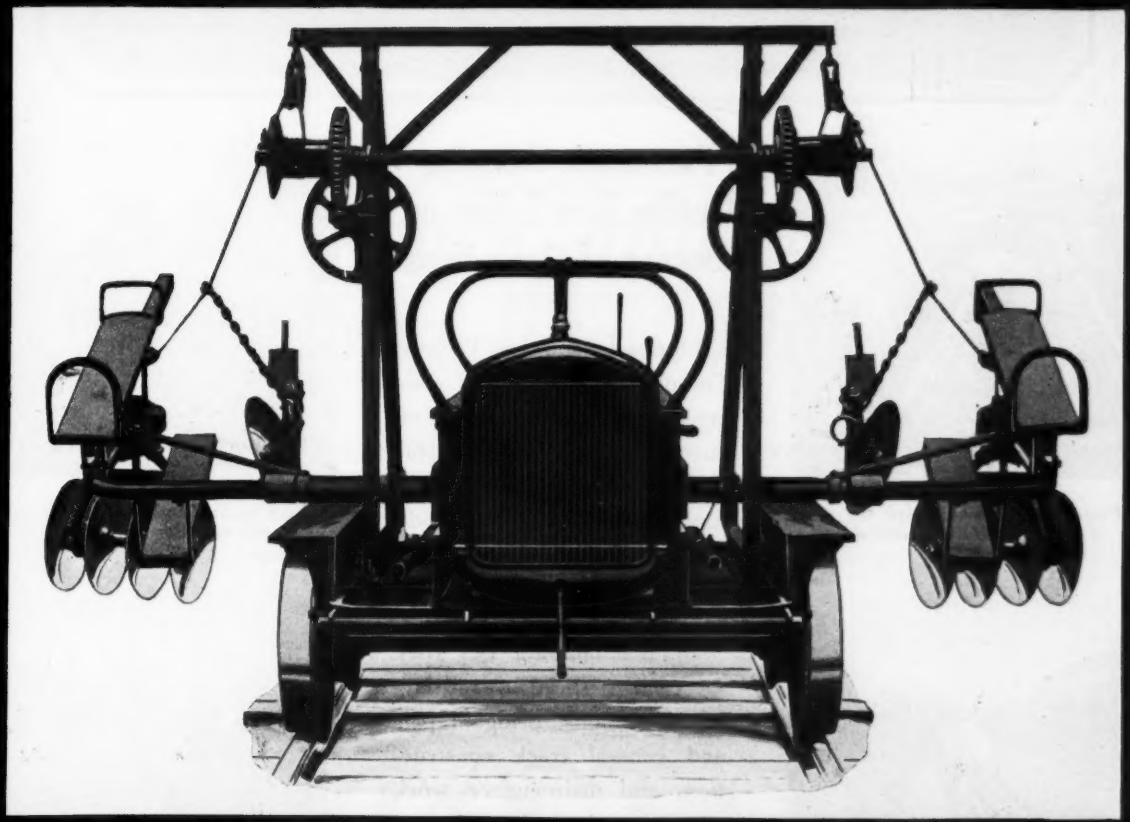
Ballast Discer

WITH WORM GEAR ADJUSTMENT of DISC HEADS and MECHANICAL ELEVATING DEVICE



Weed Destruction—Ballast Agitation and Drainage—Establishes a Perfect Grass Line—Shapes Shoulders Giving Desired Contour—Improves the General Appearance and Condition of the Right of Way—Operates in All Kinds of Ballast—Small Investment and Low Cost of Operation Per Mile—An All-Purpose Heavy-Duty Railway Motor Car

NORTHWESTERN MOTOR COMPANY

EAU CLAIRE, WISCONSIN, U. S. A.

Pneumatic wrenches work ten times faster than hand methods.

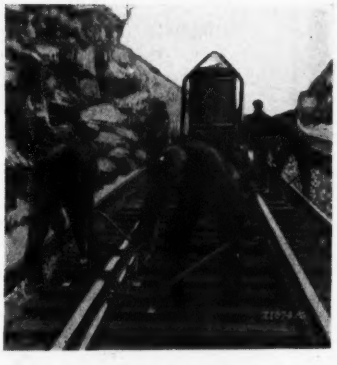
Pneumatic Tamping Outfits Save Labor on Dozens of Operations

Ingersoll-Rand Tie Tamper Compressors are such convenient and handy sources of power that they are used on dozens of operations. They supply air power for a wide variety of labor-aiding pneumatic appliances.

Besides tamping ties they are used to speed up rail laying operations, bridge repair and general track construction, and maintenance work anywhere along the line.

INGERSOLL-RAND COMPANY
11 BROADWAY NEW YORK CITY

Offices in principal cities the world over
For Canada Refer—Canadian Ingersoll-Rand Co., Limited, 10 Phillips, Square, Montreal, Quebec.



Drilling ⅜ in. bond holes in 15 seconds with Bonding Drills

Drilling ⅞ in. hole through rail in 30 seconds with No. 9 Rail Drill

Driving spikes in 6 seconds with CC Spike Drivers.

Ingersoll-Rand

Track work and long-lived shovels—

There is just one brand of shovel that has generations of long lived service behind it.

That is the shovel with the famous AMES Bend, often copied, never duplicated. For real shovel service a genuine O. AMES Shovel has the preference the world over.

O.AMES SHOVELS

SHOVELS-SPADES-SCOOPS

At good supply houses everywhere

AMES SHOVEL & TOOL COMPANY - Ames Building, Boston

Owner of Oliver Ames & Sons Corporation, North Easton, Mass. Established 1774.

1602

KREOLITE

Aerial View of Part of the Toledo Plant of The Jennison-Wright Company

Framing of Timbers "BEFORE" Treatment Is Essential

For seventeen years we specialized in the framing of timbers before treatment. No matter how difficult, we are able to efficiently frame to your plan.

The life of treated timber depends upon the character of the preservative used. *We distill our own Creosote.* By so doing it is possible for us to insure to the purchaser a uniform pure product of any grade desired.

Enormous stocks of Railroad Cross and Switch Ties, Structural Timbers and Piling, in all sizes, of Solid Oak or Pine, properly sticked and air seasoned before treatment, available for prompt shipment.

THE JENNISON-WRIGHT COMPANY, TOLEDO, OHIO

Branches in All Large Cities

R.R. TIES

The longest *station to station* call within the U.S. now costs only $10

An Advertisement for Bell Long Distance Telephone Service

THE longest telephone call you can make within the U. S. is from Eastport, Maine, to the town of Bay, California. Under the new rates, the station to station day charge for this call is now only $10.

More than ever you will now be surprised how little long distance calls cost. Business more and more is using the long distance telephone to save trips, buy and sell goods, make appointments and collections, get important things done on time.

A New York company made 14 long distance calls to department stores in 13 cities and sold $37,320 worth of specialties, "all of the transactions having been started and completed by Long Distance at a very nominal cost." A firm of Toledo brokers in one year sold $5,000,000 worth of produce by long distance calls. "Seventy-five per cent of our bean business is done over the telephone. . . . We can get in closer touch with the buyer and understand conditions at his end of the line." In eight months, a tire concern sold $3,180,000 worth of tires by telephone at a sales cost of 2%.

What far-away calls could you profitably make, now? Just ask for the long distance operator and place your call by number . . . it takes less time. . . *Number, please?*

This New Design *Improves* Drain Efficiency

THE presence of copper and molybdenum in Toncan Iron drains increases resistance to corrosion and guarantees a longer life.

But long life is not enough.

During this long life the drain must be efficient in carrying off water from the adjacent soil. In the Toncan Type "B" Drain, efficiency has been greatly increased by replacing the usual holes by rows of outward-tongued perforations which retard the entry of dirt.

Not only do Toncan Iron drains last longer, but during their whole long life they perform their work more efficiently.

TONCAN COPPER Mo-lyb-den-um IRON

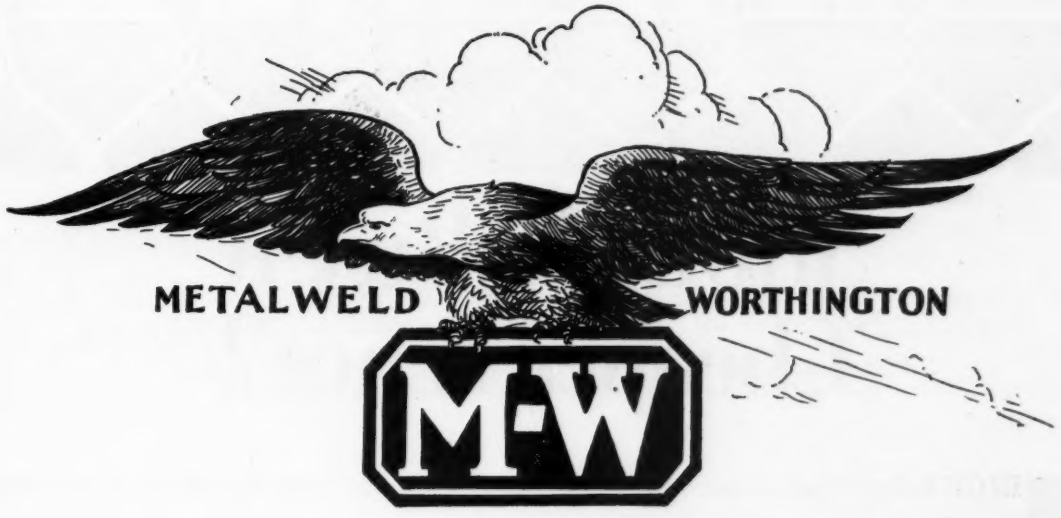
Following are the makers of Toncan Culverts. Write the nearest one:

The Berger Mfg. Co., of Mass. Boston, Mass.
The Berger Manufacturing Co. Dallas, Texas
The Berger Manufacturing Co. Jacksonville, Florida
The Berger Manufacturing Co. Minneapolis, Minn.
The Berger Manufacturing Co. Philadelphia, Pa.
The Berger Manufacturing Co. Roanoke, Virginia
The Canton Culvert & Silo Co. Canton, Ohio
The Firman L. Carswell Mfg. Co. Kansas City, Kan.
The Pedlar People Limited, Oshawa, Ontario, Canada
Tri-State Culvert Mfg. Co. Memphis, Tenn.
Tri-State Culvert Mfg. Co. Atlanta, Ga.
The Wheat Culvert Co., Inc. Newport, Ky.

CENTRAL ALLOY STEEL CORPORATION, *Massillon*, OHIO
World's Largest and Most Highly Specialized Alloy Steel Producers
Makers of Agathon Alloy Steels

Cleveland Detroit Chicago New York St. Louis
Syracuse Philadelphia Los Angeles Tulsa
Cincinnati San Francisco Seattle

TONCAN COPPER MO-LYB-DEN-UM IRON



See the New AIR KING at the Chicago M-W Show

Showing a New Development in Railcar Portable Air Compressors

Railway engineers — division engineers — railroad executives interested in effecting important savings in operating expense and labor costs will visit

BOOTH NUMBER 212

at the Maintenance-Way Show at Chicago, March 5th to 8th. There will be displayed one of the most important lines of Air Compressor Equipment ever presented to the industry.

Metalweld-Worthington Engineers will exhibit, for the first time, a remarkable series of AIR KING Railway Mounted Compressor Units—with features hitherto unheard of—with the most advanced constructional details ever devised by modern engineering.

The complete line of M-W Portables built on railcar units have been thoroughly tried and tested in the contracting and public utility field.

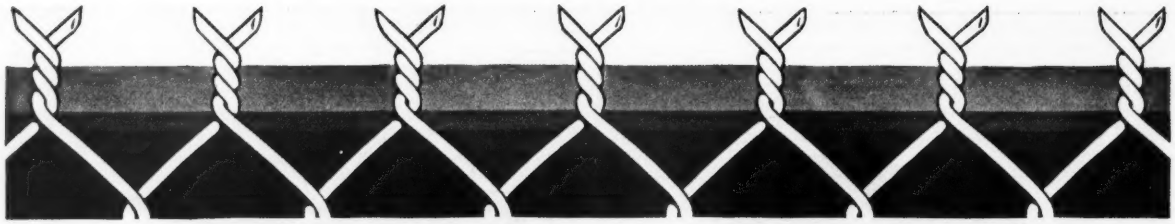
Don't miss this Show—and by all means visit BOOTH No. 212, and see what M-W can give you in the way of high-powered, efficient, cost-cutting Air Compressor Equipment.

METALWELD, INC.

26th & Hunting Park Ave., Philadelphia, Pa.

Metalweld-Worthington

Portable Air Compressors



Should I Buy a "Cheaper" Fence?

PRICE is important — but what does it mean? When you buy a cheap fence what do you get for your money? Do you actually make a saving?

To determine the economy of any fence you must look beyond the price — to the multitude of parts and variety of materials that go into it. And, even further, to the way in which the fence is erected.

There are many methods of cheapening fence. Ways to cut corners, difficult to detect. Skimping on materials. Using pick-up parts. Omitting essential items. Side-stepping efficient erection practice.

Know your fence before you buy. Know how it is built and how it will be erected. Then, and only then, can you buy fence economically.

Near you there is a Cyclone representative who knows fence from A to Z — from the raw materials to the finished installation. He has operated fence manufacturing machines in Cyclone plants, studied fence engineering, worked on Cyclone erection crews, and supplemented this training with extensive experience in the application of fencing.

He is a seasoned fence man, mature in his judgment, capable of consulting with you on any phase of property protection fencing. Without obligation write, phone or wire nearest offices and have a Cyclone representative call. Then ask yourself this question ... *"Should I Buy a Cheaper Fence?"*

Cyclone Fence

REG. U. S. PAT. OFF.

Fencing for residences, estates, schools, playgrounds, factories, property of all kinds.

CYCLONE FENCE COMPANY Main Offices: Waukegan, Ill.

Works and Offices: North Chicago, Ill., Cleveland, Ohio, Newark, N. J., Fort Worth, Texas
Pacific Coast Distributors: Standard Fence Co., Oakland, California, Northwest Fence & Wire Works, Portland, Oregon.
Direct Factory Branches: Atlanta, Boston, Buffalo, Baltimore, Charlotte, Cincinnati, Des Moines, Denver, Detroit, Grand Rapids, Mich., Hartford, Conn., Houston, Indianapolis, Jacksonville, Fla., Kansas City, Los Angeles, Minneapolis, Minneola, N. Y., Milwaukee, New Orleans, Philadelphia, Pittsburgh, St. Louis, San Francisco, Seattle, Syracuse, Toledo, Tulsa.

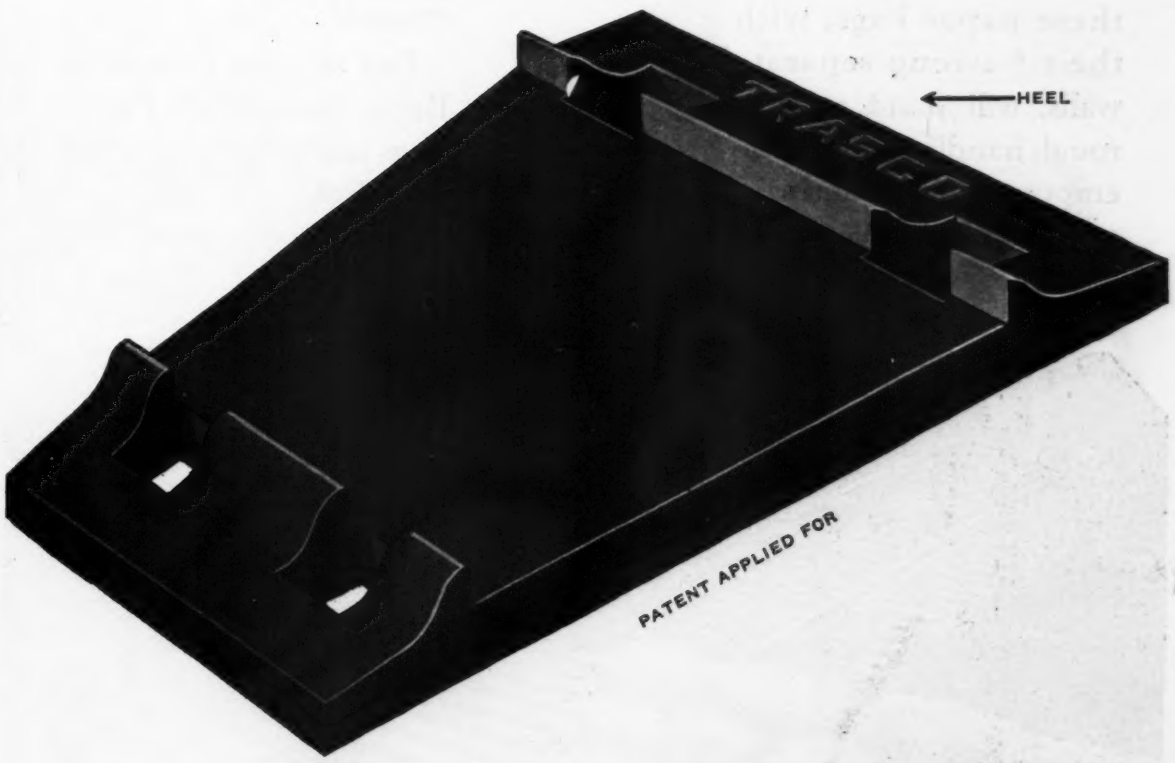
©C. F. Co., 1928

TRASCO

TRADE MARK REGISTERED

TRAPEZOIDAL TIE PLATE

"Always On The Level"



This plate doesn't take a heel dive into the tie

Write us for data and prices

TRACK SPECIALTIES CO.

29 BROADWAY

NEW YORK

Cable Address: "TRASPECIAL"

No matter what the weather, BATES Multi-Wall PAPER BAGS protect your cement from moisture

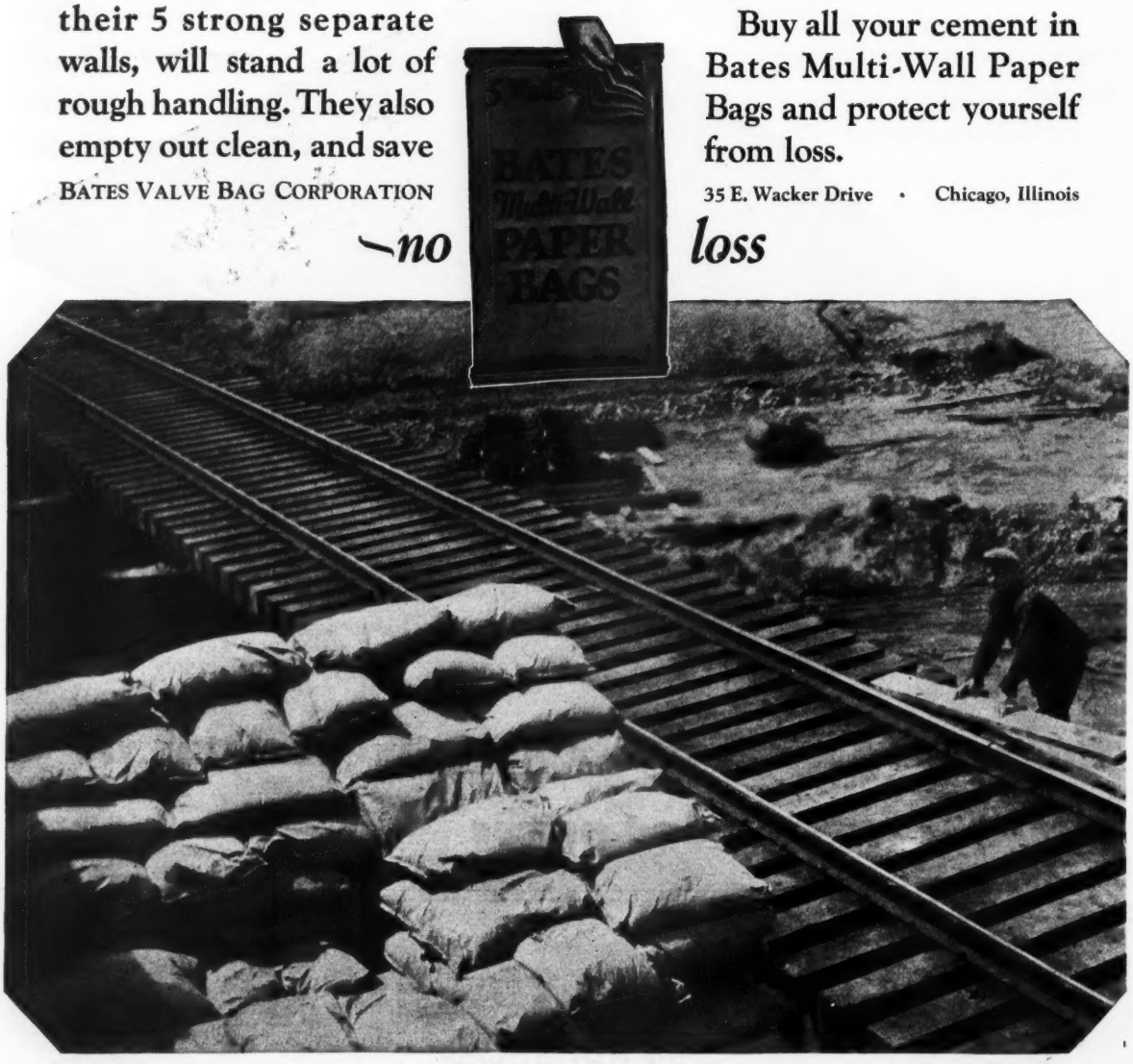
And remember, too, that these paper bags, with their 5 strong separate walls, will stand a lot of rough handling. They also empty out clean, and save you the bother of bag returns!

Buy all your cement in Bates Multi-Wall Paper Bags and protect yourself from loss.

BATES VALVE BAG CORPORATION

35 E. Wacker Drive • Chicago, Illinois

—no loss



BATES Multi-Wall PAPER BAGS

The product of experience

THIS booklet is based on years of specialized experience with reinforced concrete pipe for railway culverts, cattle passes and drainage lines. It is full of practical suggestions on unloading, handling, placing, grouting and back-filling. Special conditions like swampy ground are discussed, common mistakes like parallel lines too close together are pointed out.

Every man in the bridge and roadway departments will find this booklet valuable. A copy will gladly be sent to you on request.

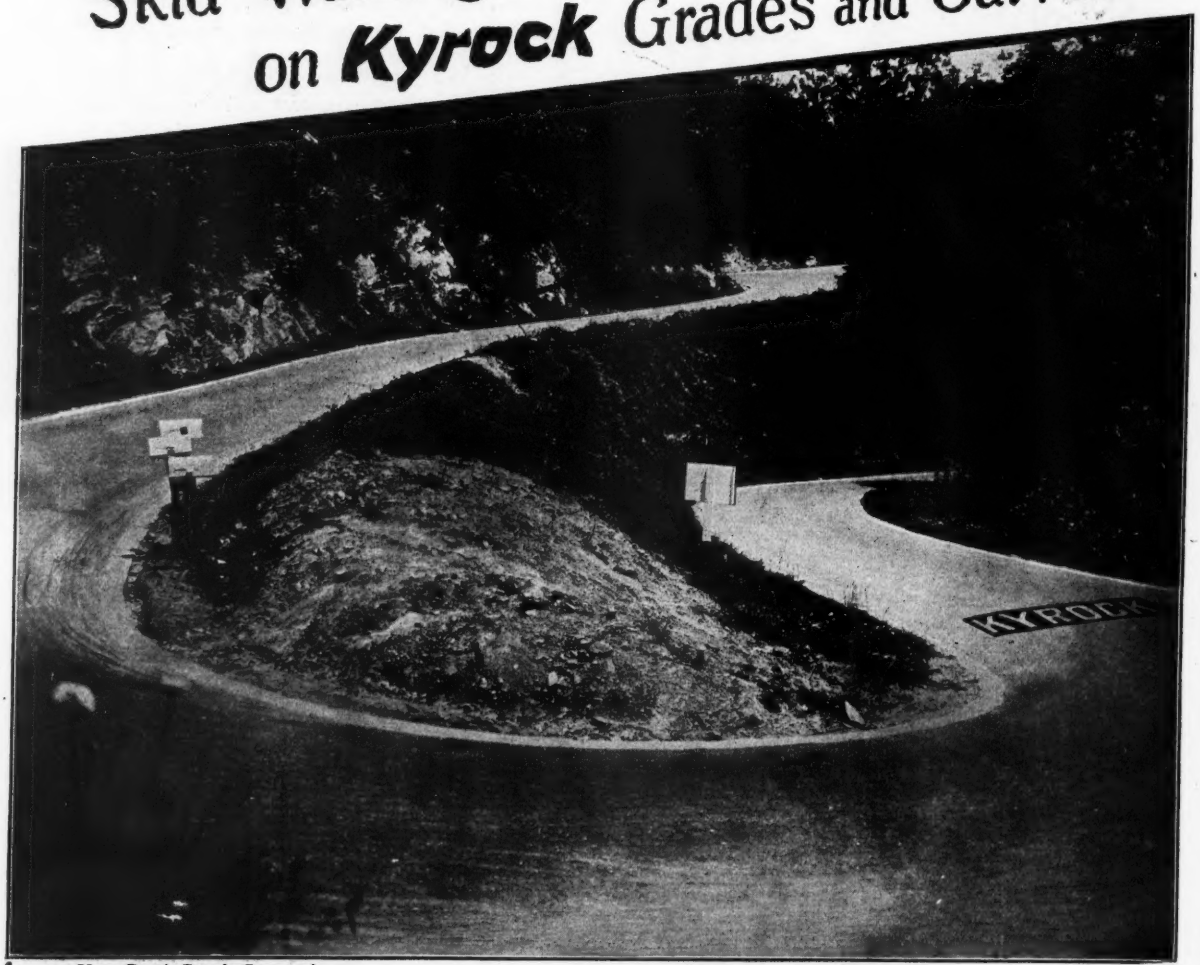
MASSEY
Concrete Products Corp.
Peoples Gas Building, Chicago
Sales Offices:
New York, Atlanta, Cincinnati, St. Louis
Los Angeles
Canadian Concrete Products Co., Limited
Transportation Building, Montreal, Que.

MASSEY
REINFORCED
CONCRETE
CULVERT
PIPE
MASSEY REINFORCED
Handling and Laying Concrete Pipe
THE smaller sizes of concrete pipe are usually loaded for shipment lying down, either crosswise or lengthwise of the car, while the larger sizes are shipped standing on end. Where a derrick car or locomotive crane is available for unloading, the chain sling has proved its value. When made of ⅞ or ¾-inch chain with a spreading bar made of an old rail, I-beam, or channel, it will lift and turn pipe without danger of slipping.
When so ordered, concrete pipe can be provided with a lifting hole at the top in the center of gravity. An eye-bolt can be inserted in the hole from above, a block of wood slipped over the bolt inside the pipe and held in place by a washer and nut. The hook on the lifting block of the crane can then be inserted in this eye and the pipe swung off without further adjustment.
When power equipment is not to be had for unloading pipe from cars, trucks or wagons, a chain hoist and skids are needed. Particular care should be used to see that stout skids are provided, down which the pipe can be rolled. Sufficient line should be at hand to carry the pipe down slowly and it should not be disengaged until the pipe is in a position where it will not roll. When pipe shipped standing up is tipped over on the car preparatory to skidding off, a sufficient cushion should be placed for it to fall on.
Laying pipe on level ground requires very little lifting and frequently the tripod is the simplest and most effective means of handling. The only equipment needed in addition to the tripod is the ever useful chain block.
laying pipe under old fills or under trestles where head room is limited, chain blocks are very useful in up the sections. A dead man can be set on line pipe and the chain block attached to it. The pole
Two ways of lifting pipe with a crane—The eye-bolt at the center of gravity, and the chain sling.
Crane setting first section of a culvert to replace old trestle.
Skidding pipe being used for unloading.
Tripods can easily be made at the site of the work

REM2-Gray

MASSEY

Skid Warning Signs Unnecessary on *Kyrock* Grades and Curves



Haw Creek Road, Buncombe County, N. C. Kyrock surface laid by County forces on macadam base. Road constructed 1925. Photo 1927.

KYROCK presents a sandpaper-like surface of fine silica sand that, wet or dry, affords ideal traction for rubber tires. A Kyrock road *does not become slippery when wet. Investigate Kyrock.*

KENTUCKY ROCK ASPHALT CO., *Incorporated* LOUISVILLE, KY.

Kyrock

The **Perfect Pavement**

KENTUCKY ROCK Kyrock ASPHALT

Freight Cars are Business Insurance

IN YEARS PAST freight car shortages made it necessary for merchants and manufacturers to lay in excessive stocks twice a year. Factories worked overtime to fill orders and then shut down, turning millions out of work.

To-day, hand-to-mouth buying is possible because car shortages have been reduced to a minimum. On October 15, 1927, the time of peak loading, there was a surplus of 158,437 freight cars—a margin of safety of 7.5 per cent. This steady, year-round business has been the cause of greater prosperity and is the best insurance for continued good times.

The Oxweld Railroad Service Company has been a factor, contributing to more efficient railroading for over 15 years. It is an organization composed of men who have had years of experience supplying oxwelding service to many of the largest railroads of the country.

Oxweld Railroad Service

THE OXWELD RAILROAD SERVICE COMPANY
Unit of Union Carbide and Carbon Corporation
New York City: Carbide and Carbon Building
Chicago: Railway Exchange

THE WOOD ETERNAL

A hundred-year test of wood!

WOODEN water mains — moisture attacking from within, rot gnawing from without! What could better test the durability of lumber?

In 1793, New Orleans laid logs of Tidewater Red Cypress for its water supply. When dug up recently, these logs were still sound, still useful, after more than a hundred years of hard service.

Although laid in 1793, and put to such a severe test of its durability, this water main was in fine shape when dug up recently.

This striking testimony is only one of the thousand proofs of the durability of Tidewater Red Cypress. This lumber is used the world over in ship building. Millions of railroad ties are made of it. Many houses built of it are over two centuries old, and the country is still too young to know how long a cypress structure can endure.

When you order this Wood Eternal, be sure to specify "heart grade Tidewater Red Cypress" —for such durability is found only in "coastal type" red cypress.

Complete information will gladly be sent on request. Southern Cypress Manufacturers' Association, Department RE2, Jacksonville, Florida.

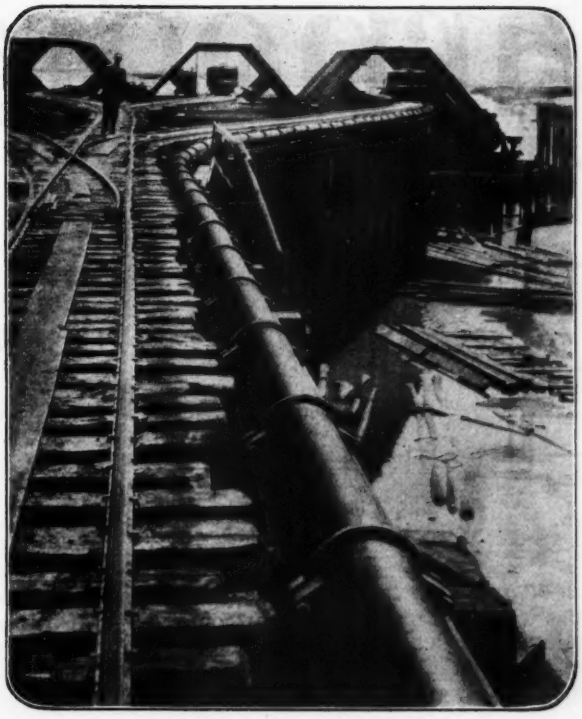
Tidewater Red Cypress is especially adapted for:

Passenger station construction
Freight sheds and warehouses
Platform construction
Conduits for signalling systems
Water tanks—box cars—cattle cars—refrigerator cars
Fencing

In short, any use where long life and absolute freedom from repairs are essential.

Specify TIDEWATER RED CYPRESS

THE WOOD ETERNAL



A Partial List of Railroads using Universal Pipe

FLORIDA EAST COAST
NEW YORK, NEW HAVEN & HARTFORD
CHICAGO AND NORTHWESTERN
CHICAGO, BURLINGTON AND QUINCY
LONG ISLAND
LOUISVILLE & NASHVILLE
DELAWARE, LACKAWANNA & WESTERN
MOBILE & OHIO
CANADIAN PACIFIC RAILWAY
PENNSYLVANIA LINES
BOSTON & ALBANY
BOSTON & MAINE
CENTRAL VERMONT
WHEELING & LAKE ERIE
INTERNATIONAL RAILWAYS OF CENTRAL AMERICA
TRUXILLO R. R. OF HONDURAS
TELA R. R. OF HONDURAS

Easier Quicker Safer

Savings all along the line

Wrenches the only tools!

THE ONLY cast iron pipe that eliminates all jointing materials and equipment. Universal Pipe does away with pouring, calking, lead, lead substitutes, melting pots, ladles, furnaces, fuel and the rest of the paraphernalia required in making the ordinary pipe joint.

There is nothing to deteriorate, nothing to work loose in the Universal Pipe joint. The hub and spigot ends, machined at slightly different tapers, are drawn into direct contact, forming a flexible joint that amply provides for expansion and contraction, vibration and uneven ground settlement. Curves laid with standard 6-foot lengths.

Wrenches the only tools. Experienced labor unnecessary. Installed practically anywhere, in any season. Thousands of miles laid every year.

Put your water supply and other pipe problems up to our nearest office: New York, Graybar Building, Lexington Avenue at 43rd Street (adjoining Grand Central Terminal) . . . Chicago, McCormick Building . . . Birmingham, Comer Building . . . Dallas, Praetorian Building . . . San Francisco, Rialto Building.

UNIVERSAL CAST IRON PIPE

No bell holes to dig: No joints to calk

THE CENTRAL FOUNDRY COMPANY

Subsidiary of The Universal Pipe and Radiator Company

Graybar Building, 420 Lexington Avenue

Chicago Birmingham New York Dallas San Francisco

B-3

Carnegie

—the name associated with steel manufacture for more than sixty years —the name that signifies GOOD STEEL

Carnegie Beam Sections—A new series of 42 beam sections which greatly simplify the construction of bridges and buildings, in that they simplify fabrication. These sections are of special interest to railroad engineers in grade-crossing elimination work and for bridge floor construction.

Rails—Standard and miscellaneous sections. Extensive manufacturing facilities assure prompt delivery.

Rail Joints—Carnegie high carbon, oil quenched and heat treated rail joints are standard equipment on many important railroad systems.

Steel Cross Ties—Included in the many purposes for which Carnegie Steel Cross Ties are especially well adapted is their use in yards and at ash pits.

Steel Sheet Piling—United States Steel Sheet Piling is easily driven, has continuous interlock, and is water tight. Ideal for retaining walls, etc.

Catalogues on any of the above products will be sent at your request.

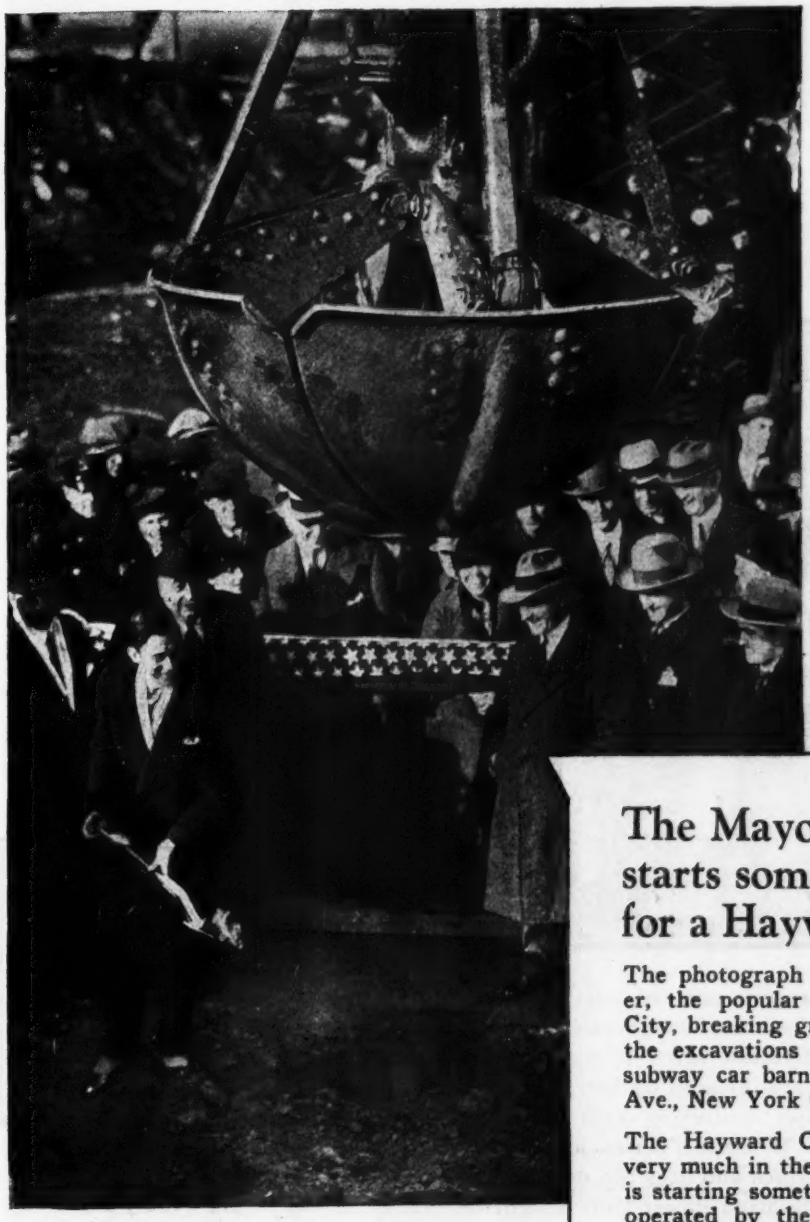
CARNEGIE—the name to look for on Steel

1860-B

CARNEGIE STEEL COMPANY

General Offices • Carnegie Building • 434 Fifth Avenue

PITTSBURGH PENNSYLVANIA



Hayward Standard Orange Peel Bucket

A power wheel bucket of the two line type, one line being used for closing and digging, the other for holding the bucket while it is opening and discharging.

The Mayor starts something for a Hayward to finish

The photograph shows "Jimmy" Walker, the popular Mayor of New York City, breaking ground with a spade for the excavations on the new $4,000,000 subway car barn at 207th St. and 10th Ave., New York City.

The Hayward Orange Peel Bucket is very much in the picture for the Mayor is starting something which the bucket, operated by the Eastern Construction Co. will finish.

Hayward Orange Peel Buckets are very much in the picture in *any* tough digging assignment. In hard-packed soil—in outdoor winter excavation, or in muck, mire and underwater work, this type of all-around contractor's bucket is equally at home.

Hayward Buckets

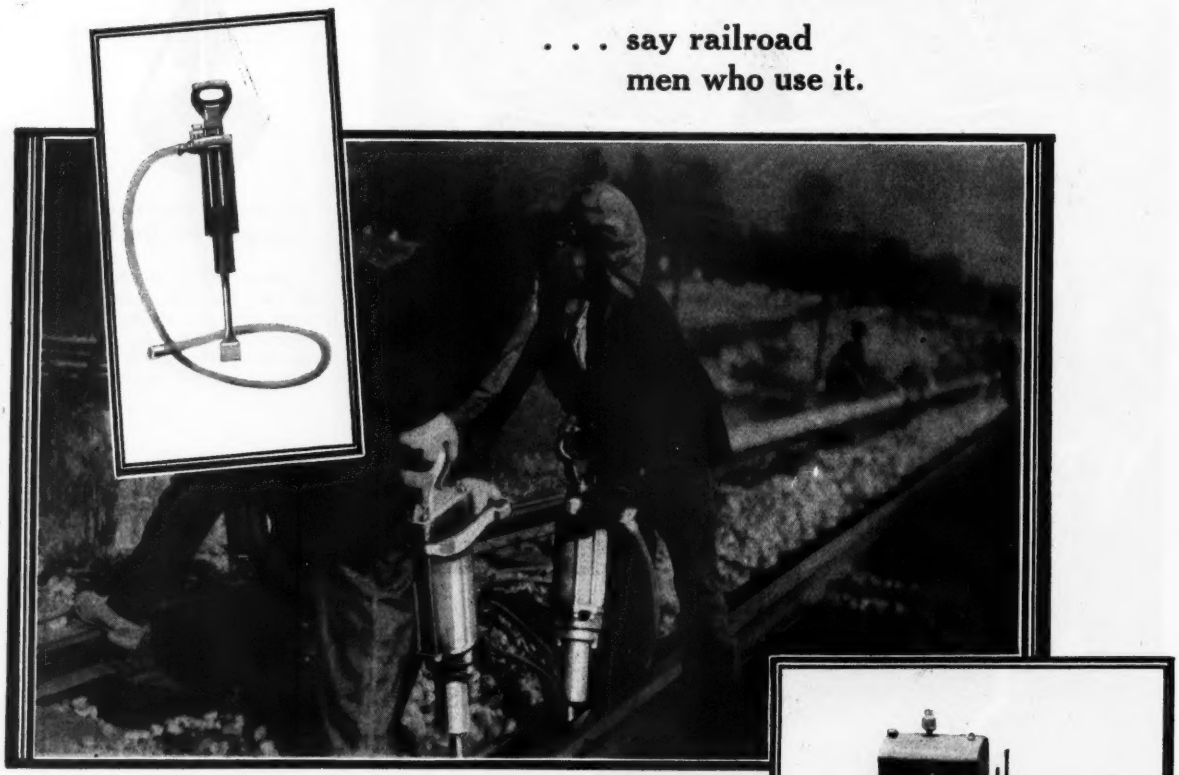
THE HAYWARD CO.
46 Dey Street, New York, N. Y.

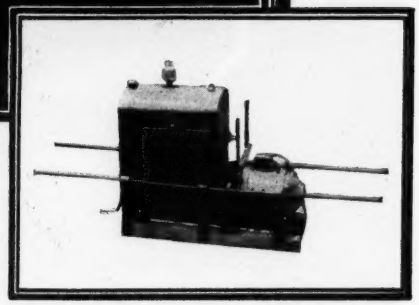
Builders of Clam Shell, Orange Peel, Drag Line and Electric Motor Buckets; Dredging Excavating, and Coal Handling Machinery; Automatic Take-Up Reels; Counterweight Drums.

—HAYCO—

"The Syntron tamper gives the best results"

. . . say railroad men who use it.





The Syntron Power Unit

This unit consists of a gas engine and a 110 volt A. C. generator. Runs automatically—requires absolutely no attention other than for gas, oil and water, automatically supplying the current for the Syntron Tie Tampers as well as any other portable electric tool used in maintenance work.

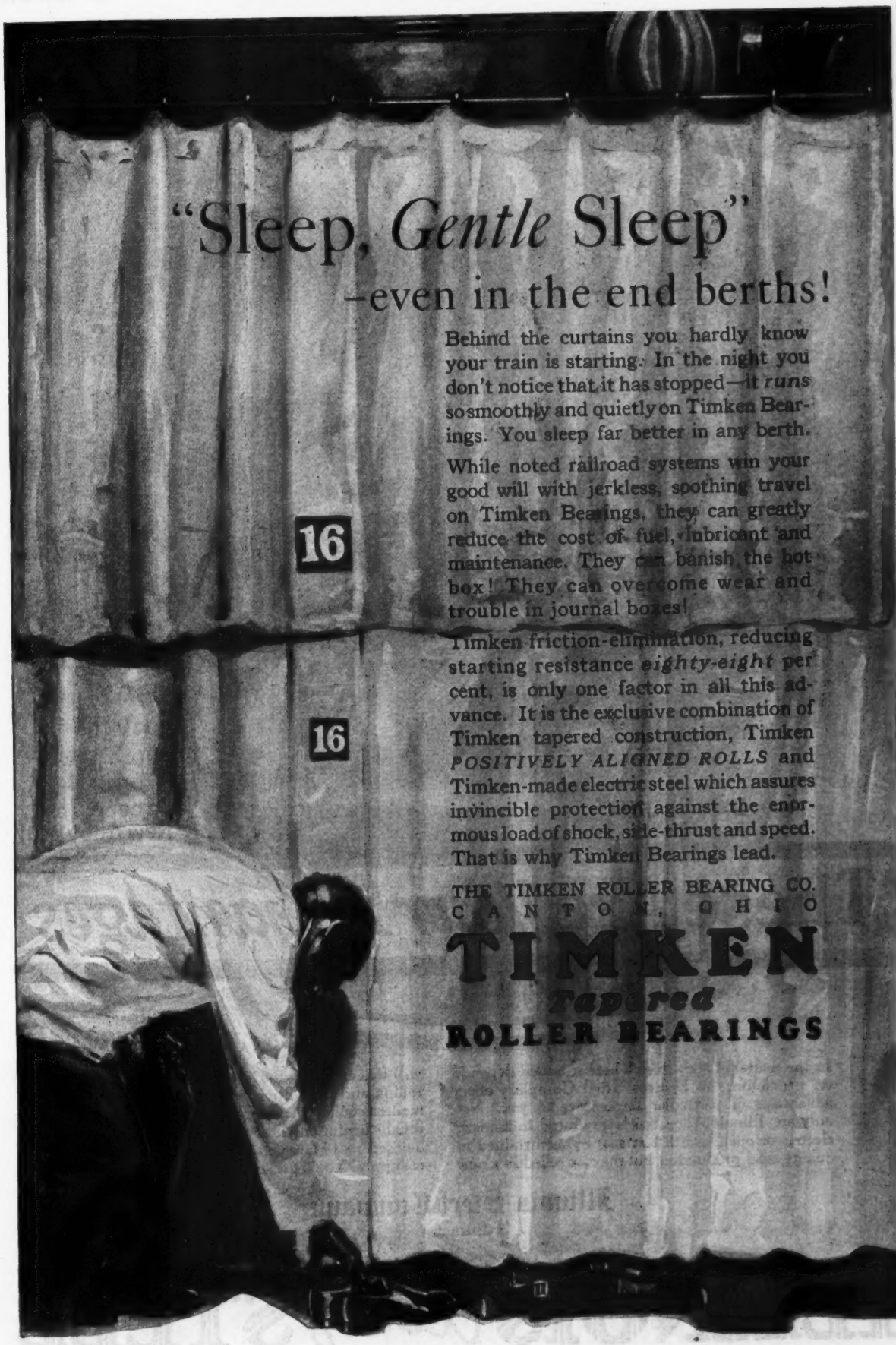
Many of America's largest railroads are showing healthy reductions in track surfacing costs with the Syntron Outfit. The Syntron saves in many ways. Twelve men with picks are replaced by four men with the Syntron, each tamper delivering 1500 powerful, speedy blows a minute. It tamps a better, longer-lasting bed, makes a firmer track and does not damage ties nor crush ballast. The Syntron Power Unit is light in weight, only 20 inches wide, equipped with Dolly wheels for moving, and is easily moved by only four or five men.

Learn the whole interesting story about Syntron Outfits—data and costs supplied without obligation. Write today.

SYNTRON COMPANY PITTSBURGH, PA.

SYNTRON

Electric Tie Tampers


"Sleep, *Gentle* Sleep"
–even in the end berths!
Behind the curtains you hardly know your train is starting. In the night you don't notice that it has stopped—it *runs* so smoothly and quietly on Timken Bearings. You sleep far better in any berth.
While noted railroad systems win your good will with jerkless, soothing travel on Timken Bearings, they can greatly reduce the cost of fuel, lubricant and maintenance. They can banish the hot box! They can overcome wear and trouble in journal boxes!
Timken friction-elimination, reducing starting resistance *eighty-eight* per cent, is only one factor in all this advance. It is the exclusive combination of Timken tapered construction, Timken *POSITIVELY ALIGNED ROLLS* and Timken-made electric steel which assures invincible protection against the enormous load of shock, side-thrust and speed. That is why Timken Bearings lead.
THE TIMKEN ROLLER BEARING CO.
CANTON, OHIO
TIMKEN
Tapered
ROLLER BEARINGS
16
16

Scene in New Alloy Mill.

These Are *Your Advantages*

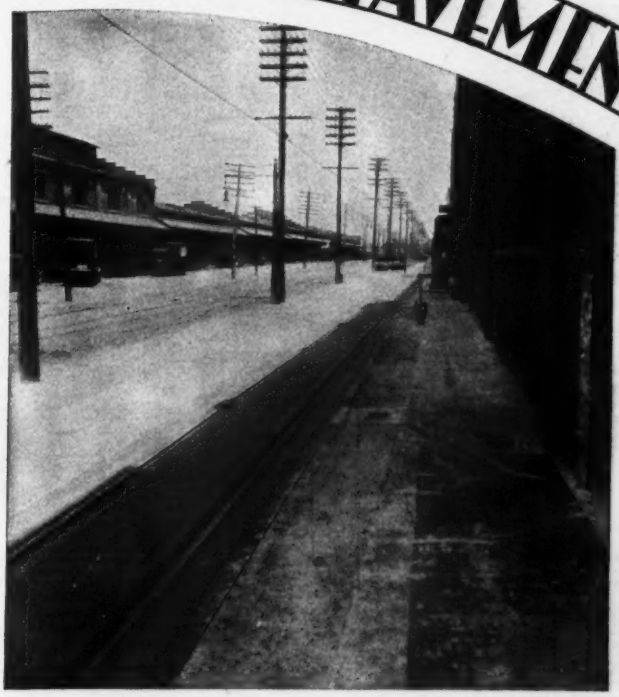
In the matter of alloy steel, where so much depends on precision, the Illinois Steel Company offers advantages of particular importance to you. Not only are Illinois Alloy Steels produced in modern electric or open-hearth furnaces by men trained in quality steel production, but they are rolled in a new mill that expresses the *last word* in close-gauge rolling, and in addition is fitted with the most modern cooling, pickling, straightening, sawing, rough-turning and heat-treating equipment yet devised. · · · Have you investigated this source of supply? You'll find it decidedly worthwhile.

Illinois Steel Company
Chicago

ILLINOIS *Alloy* STEEL

CAREY ELASTITE TRACK PAVEMENT

...the perfect protection for industrial sidings!



Siding at Fedders Manufacturing Company, Buffalo, N. Y., given the lasting protection of more than 1000 feet of Carey Elastite Track pavement. Practically every phase of track construction is involved.

BECAUSE it knits and heals under train and vehicular traffic! That's why, in practically every section of the country, Carey Elastite Track Pavement was selected to protect grade crossings and industrial sidings. This remarkable material is easy to install, too, and it adapts itself so readily to curves, switches, diamonds and tangent tracks.

Weatherproof, and it offers easy access to the rails at all times. Carey Elastite Track Pavement consists of slabs about two inches thick and sections of rail filler, both made of a fibrous, asphaltic material. Set tightly in place, by ordinary labor with ordinary tools, it forms a practically weather-tight crossing which, under favorable track conditions, will give attention-free service. Write—we'll tell you more.

The Philip Carey Company

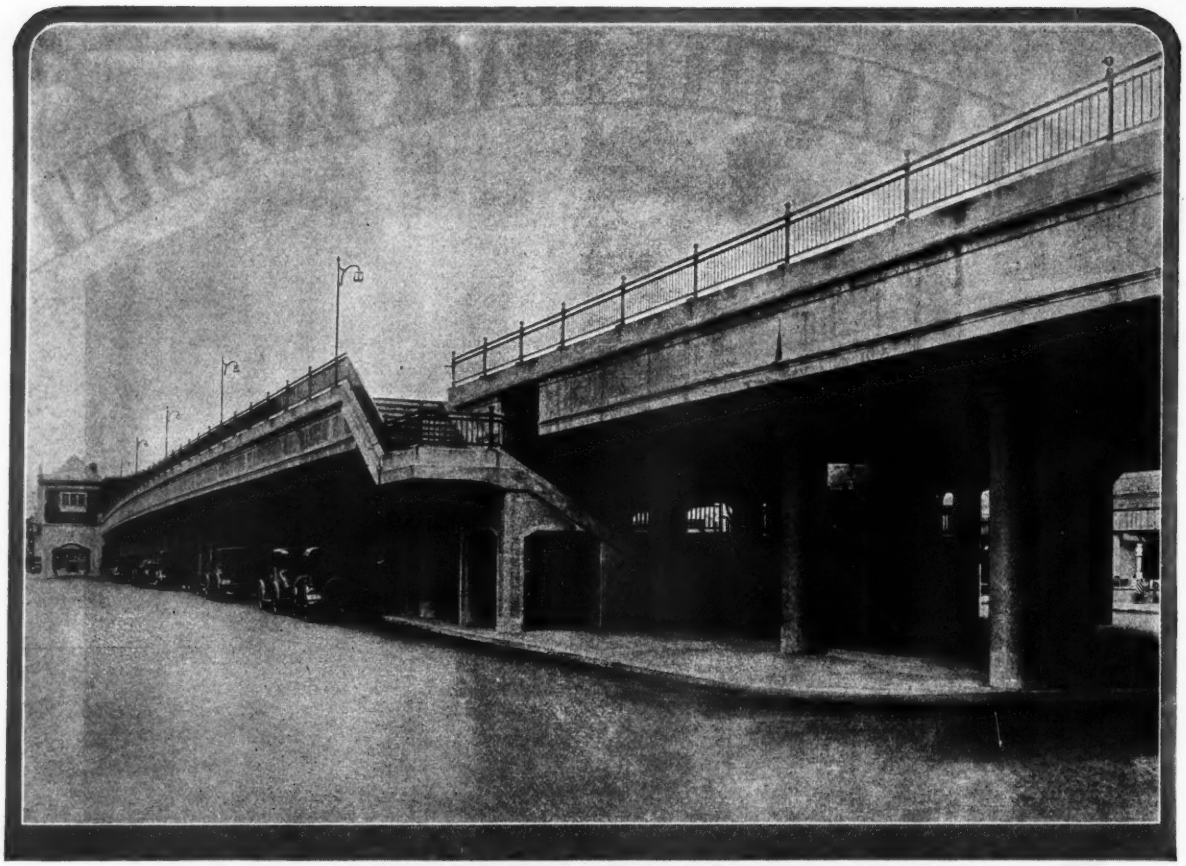
Lockland, Cincinnati, Ohio

Carey Elastite

Also manufacturers of Carey Elastite Waterproofing Protection, Carey Elastite Bridge Flooring, Carey Elastite Cable Trunking.

TRACK PAVEMENT

"Knits and heals under traffic"



Viaduct at Brick Church Station, East Orange, New Jersey.
Delaware, Lackawanna and Western Railroad
Geo. J. Ray, *Chief Engineer* - M. Hirschthal, *Concrete Engineer*

BUILT OF CONCRETE

for permanence and economy

This flat-slab viaduct built by the Delaware, Lackawanna and Western Railroad at East Orange, New Jersey, is a good example of the trend in railroad construction.

This all-concrete viaduct, 1085 feet in length, is built of slabs twenty inches thick, with supporting columns on twenty-foot centers. The advantages of this cantilever type flat-slab structure are that first cost is usually less than retaining wall and embankment, simplicity of architectural treatment, speed of construction and the availability of the space underneath.

Where tracks are to be elevated in the elimination of grade crossings the multiple-span bridge is especially effective. The shallow floor permits better adjustment and reduction of street grades, thus lessening the amount of property damage, an item of prime importance.

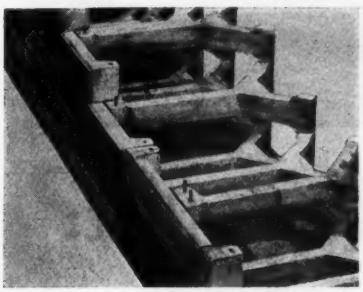
PORTLAND CEMENT *Association*

Concrete for Permanence CHICAGO

2 -piece cribbing

—the simplest, strongest construction offered today

Because of its unique design, Federal Concrete Cribbing offers advantages unequalled by any other forms of cribbing. With but two units, it represents the peak of simplicity in construction and economy in erection—the perfect alignment of the two members prevents bulging—the interlocking anchorage in the back-fill assures even greater stability than 3-piece cribbing.



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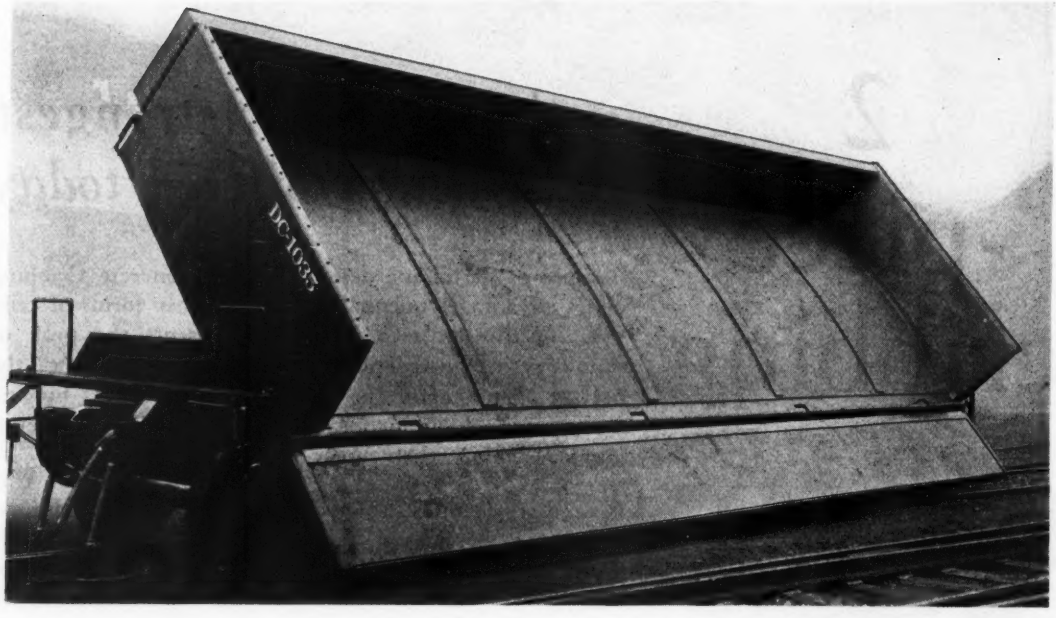

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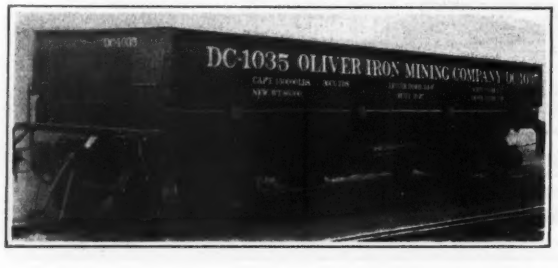

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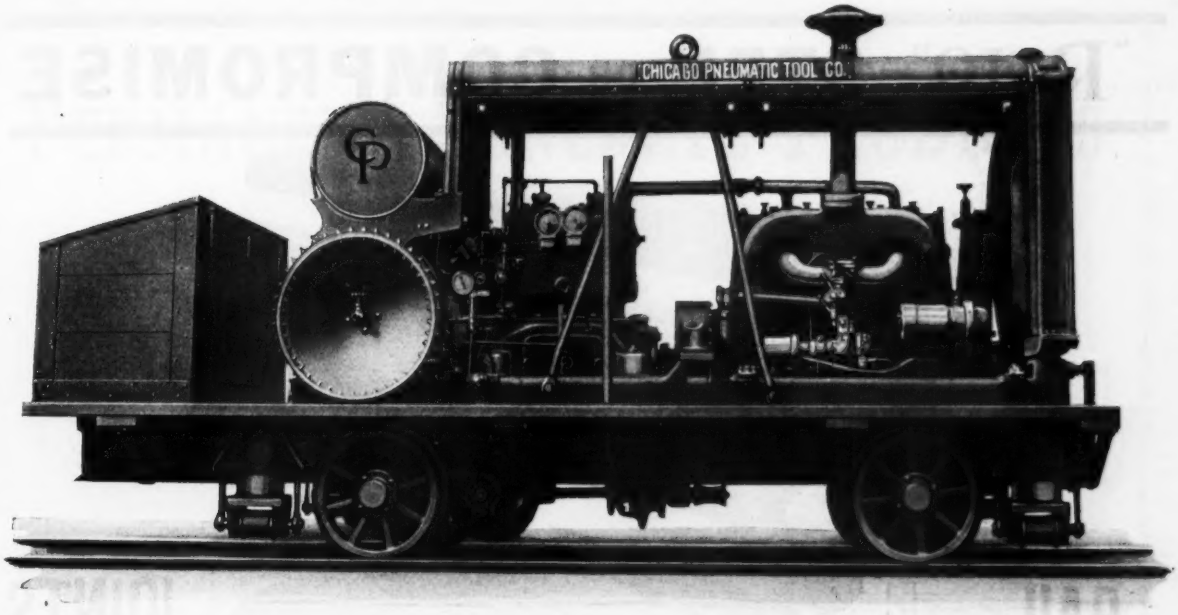

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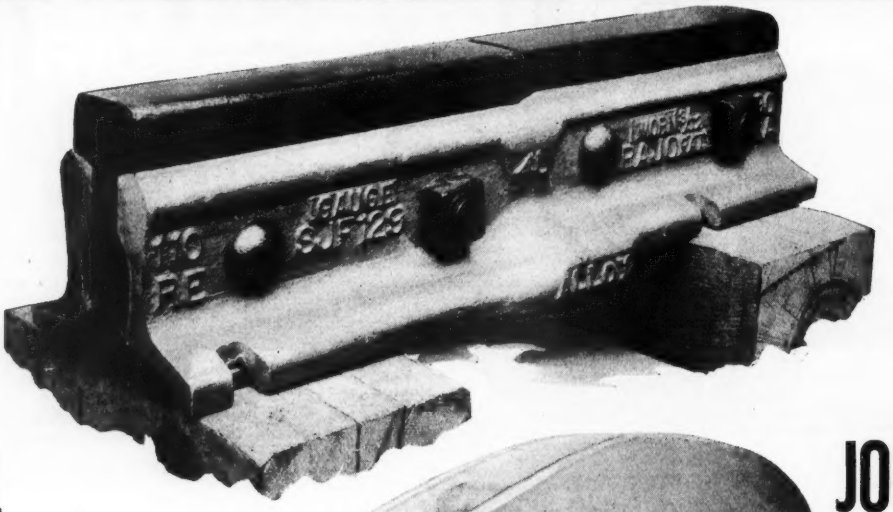

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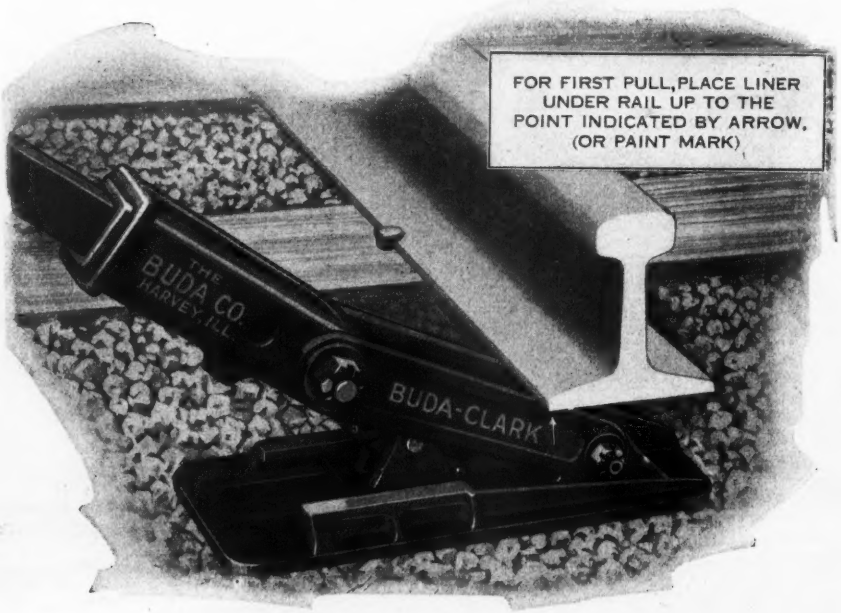

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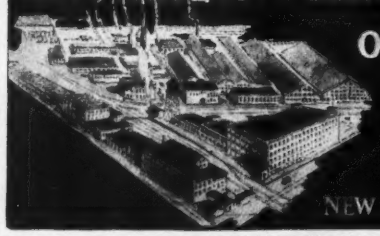

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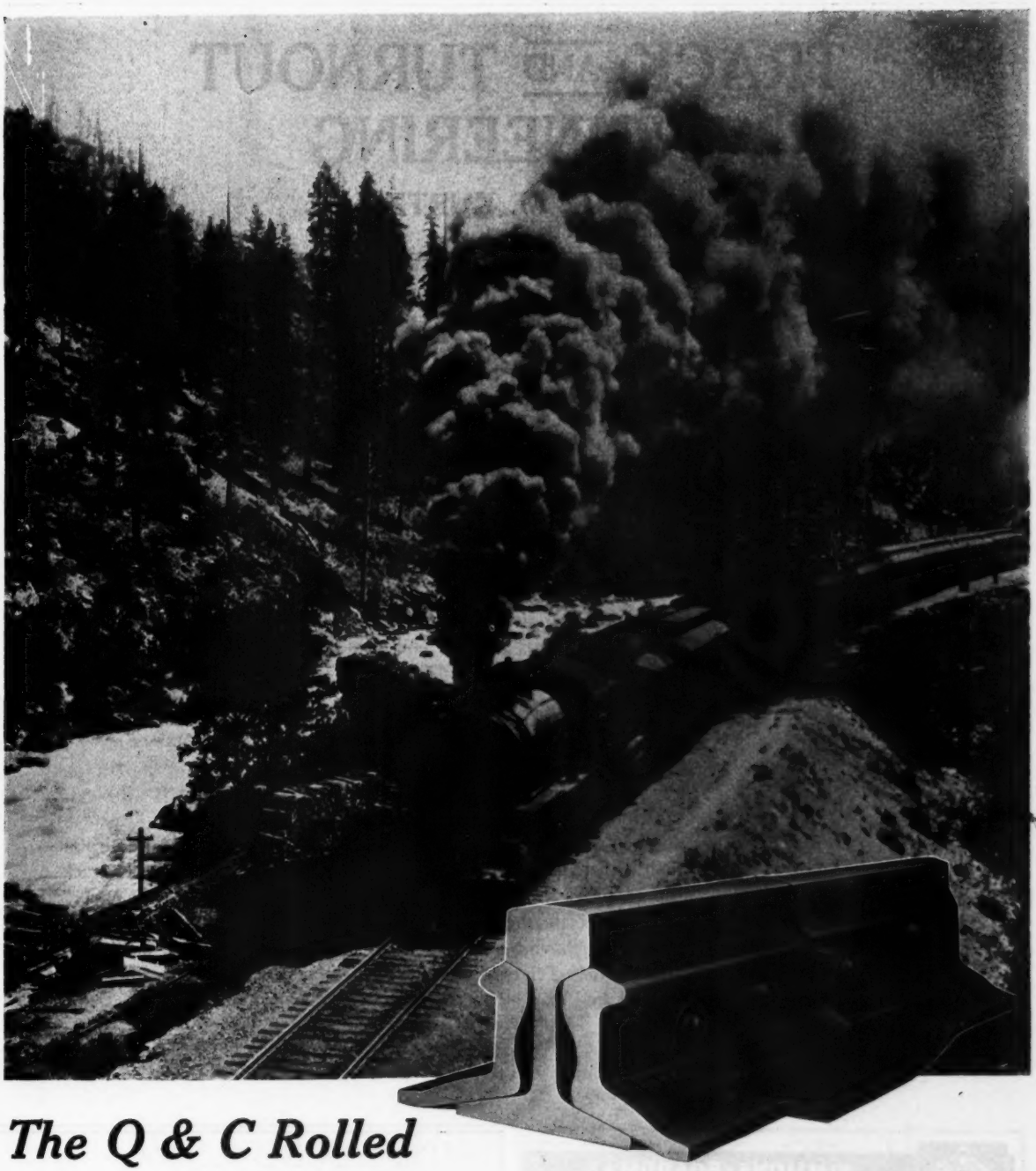

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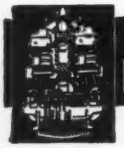

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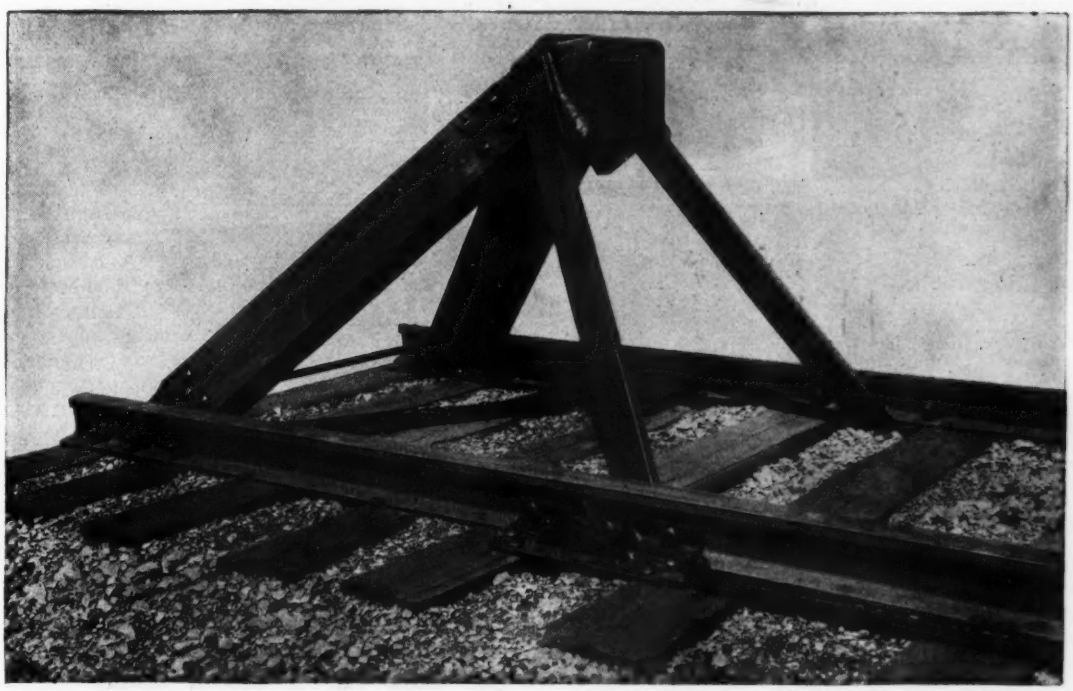

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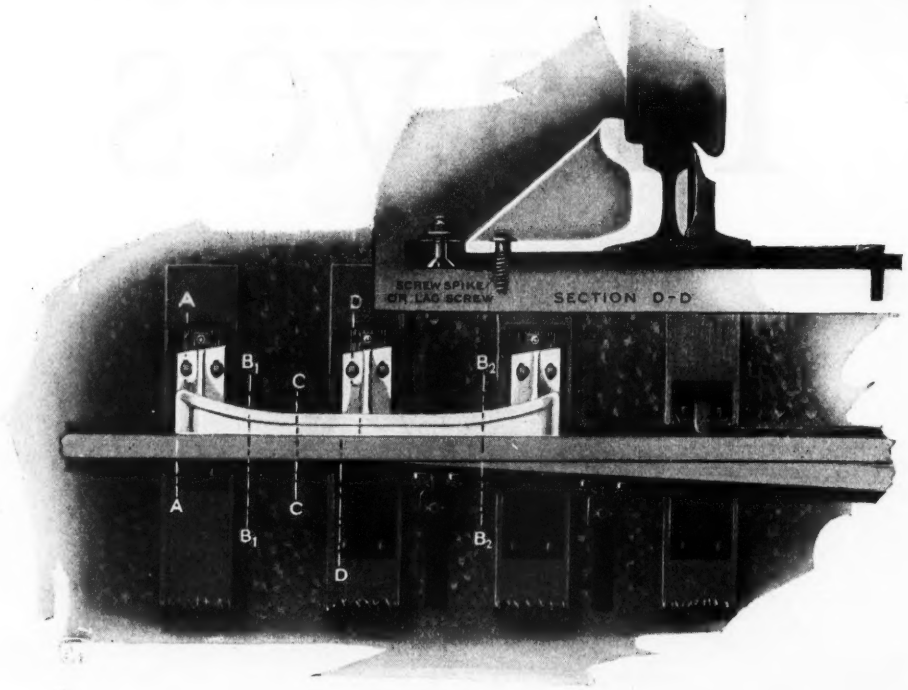

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Railway
Engineering and Maintenance

Volume 24 February, 1928 Number 2

The Snow Fence

ONE ITEM of roadway equipment that has remained practically unchanged through the years of rapid improvement of practically all other items, is the snow fence. It is in general of the same construction as was adopted when the pioneer roads pushed through the more northerly areas years ago. The board fence, of either fixed or portable construction, is still employed almost universally. The absence of change in its construction cannot be attributed to any lack of importance, for, in the aggregate, its maintenance amounts to a sizable sum. Rather this lack of development is due primarily to neglect.

In considering the possible reduction of this item of maintenance expense several expedients suggest themselves. One is a radical change in design to afford greater permanence. Since the major cause of failure is decay in the timber, or breakage promoted by decay, the treatment of this wood with preservatives has been suggested as one alternative. A still more complete and permanent change is the substitution of evergreen hedges, a practice adopted by the Canadian Pacific, as described on page 67 in this issue.

The March of Progress

THE FACT that purchases of track accessories during December and January have not followed rail purchases as closely as had been anticipated has been taken by certain authorities in the steel industry as an indication of some decrease in rail renewals during the present winter. It would be possible, of course, to determine the truth or fallacy of this statement, by extensive inquiry of the railroads, but it is, after all, a matter of little consequence. The significant thing about this comment lies in the fact that winter rail laying, has become of sufficient importance to be discussed in papers read by the iron and steel manufacturers.

Another fact clearly evidenced in current reports from the iron and steel trade, is the extent to which the railroads have been forehanded in rail purchases. By far the larger part of the rail to be laid before the fall of 1928 has been ordered. The rail mills are now operating at from 75 to 80 per cent of capacity and heavy deliveries are being made to the roads. Regardless of whether the tonnage laid during the present winter is as large as that laid last winter, it is a fact that winter rail laying is more actively discussed today than ever before. One road after another which had not previously given the matter serious consideration is actually taking up the practice or is giving it careful study.

Advance in maintenance of way methods is usually so gradual that a comparison of the practices of one year with those of the year just preceding reveals no marked change. It requires a comparison of the practices of today with those of 10 years or 15 years ago to disclose the true extent of the progress made. When it is recalled that it was only 12 years since the champions of a longer season's work were successful in having the end of the fiscal year for the Interstate Commerce Commission accounts changed from June 30 to December 31, a better appreciation is had of the marked change that has taken place since the day when most roads withheld appropriations for major maintenance work until midsummer.

The Highway Crossing

THE railways are spending considerable sums of money and many of their officers are giving a large part of their time to inform the public at large regarding railway problems and, in this way, promote a favorable public sentiment towards the roads. To this end, the attention of maintenance officers has been called repeatedly to the opportunities that come to them to further this work among those with whom they come in contact. There is another opportunity open to maintenance of way officers, however, to promote a friendly attitude towards the railways which is not as fully appreciated. This is the maintenance of highway crossings.

This is an age of rapidly increasing highway travel. There are now more than 22,000,000 automobiles in the United States or approximately one for every five inhabitants. These vehicles are used to an extent never thought of in the "horse and buggy days." The wear on the highway crossings is correspondingly severe. Furthermore, the vehicles of today move at much higher speeds than those of a decade or more ago, intensifying the effect of poorly maintained crossings. With such a large proportion of the public now riding in automobiles, the effects of rough and poorly maintained crossings are evident as never before. This places a new emphasis on the maintenance of these crossings, the responsibility for which rests on the railways.

Only a relatively short drive is necessary to show that much is yet to be desired. It is true that a vast improvement has already been made and that many crossings are now maintained in excellent condition. There is an equal or even larger number of which this cannot be said. Until these crossings are brought up to modern standards, the problem cannot be considered as solved.

Furthermore, unlike most maintenance problems, this one is not dependent on the class of line and the standard of maintenance prescribed therefor. Its standard is not fixed by the use made of the track but, rather, by the traffic on the highway. Thus, it commonly happens that the most important crossings, from the standpoint of highway travel, occur on lines of light railway

traffic and correspondingly low standards of track maintenance. It is on such lines, particularly, that the maintenance of highway crossings requires special attention, because of the greater possibility of neglect.

There is no more effective form of public relations work within the province of a maintenance officer than the proper upkeep of the highway crossings under his supervision. He determines the degree of comfort of the motoring public across the railway right of way and the motoring public is becoming more and more synonymous with the public at large.

A Labor Saving Issue

FOLLOWING the practice of the last nine years, the next or March issue of *Railway Engineering and Maintenance* will be designated the "Annual Labor Saving Issue" and its editorial contents will be confined largely to the discussion of the place that mechanical equipment is assuming in enginering and maintenance of way work. The reception that has been accorded this issue in the past is evidence of the importance that railway men are attaching to the development of ways to replace men and cut costs by the use of machinery. A glance through the issues of *Railway Engineering and Maintenance* from month to month might very properly lead one to consider each issue as a labor saving number, for it is a policy of this publication to encourage all reasonable progress of this character and to give space freely to new developments, believing that this is in the direction of greater efficiency in the conduct of maintenance work. However, the designation of a special issue and the placing therein of more than the usual amount of information of this character serves to emphasize this development still further.

The consideration of labor saving equipment during this season is particularly pertinent for it is during the next 60 days that the year's work will be programmed and the methods of its conduct determined upon. It is during this period, therefore, that maintenance men are giving special consideration to the equipment that is available to aid them in the work they have in mind. The plans that the railways are now making for the improvement of their properties indicate that 1928 is going to be "another roadway year." The rapidity with which labor saving equipment is being developed for roadway use indicates that in the roadway department 1928, more than any previous year, is going to be a "labor saving year."

The Technique of Water Service

IT IS possible for a man to locate and drill deep wells successfully without training in geology; he can have an intimate knowledge of pumping machinery without being versed in the mathematics of hydraulics, and he can supervise the operation of treating plants without being a chemist. But such a man can become really expert only after years of experience, during which he has developed a sort of rule of thumb understanding of the principles involved. Within the field of his own experience he may be highly successful but outside of it his native skill gives him little or no advantage over a man who has had less experience but is familiar with what has been written on any problem under consideration. In fact, anyone who undertakes the solution of new problems of water supply without a thorough canvass of the literature on the subject, can easily waste much of his employer's money.

Railway water supply work is much more exacting than in times past. Water stations were once located where they would be most accessible to the available supplies; today, the station must be placed where it can serve the locomotives in such a way as to effect a maximum of convenience in transportation.

It is true that the water service man of today has at his disposal a much greater variety of facilities with which to carry out his work. But the problems of water service have become more complex for the very reason that a greater variety of means is available for their solution. Whereas the windmill and the reciprocating steam pump once furnished practically the only means for delivering water where a gravity flow was not possible; today, the water service man has a choice of many kinds of pumps and of a multitude of styles and types of power units, each of which is suitable for use in some particular place or under some special combination of circumstances. Further, there are various types of valves, well equipment, standpipes, control apparatus and other classes of materials and equipment, each of which has its individual technique and all of which, taken together, make up the complex technology of railway water service. Here is a field to which a man can give a lifetime of study.

A Valuable Paper

THE WOOD preserving industry has been developed around the railway cross tie. Practically from the start the output of the treating plants has been predominantly cross ties and they still form 65 per cent of the total output. Yet, only two-thirds of the ties used today are treated, more than 30 million having been inserted in track last year without this protection against decay. This is due to some extent to the fact that these ties were of inferior grades or were going into temporary tracks, where the investment to secure additional life beyond that actually required was not warranted. In a large measure, however, this extensive use of ties untreated is uneconomical and is a result of the failure of some railroads to appreciate the true economy involved.

To such roads the data presented by George J. Ray, chief engineer of the Delaware, Lackawanna & Western, on the results secured from the treatment of ties on that road over a period of 18 years are valuable. To those roads which adopted this protection of ties against decay as a standard practice in the belief that it would result in economy eventually, the results cited by Mr. Ray stand as a vindication of their judgment. His figures will also give these roads a gage by which to measure the efficiency of their practices in treatment.

The Lackawanna's experience demonstrates conclusively that, entirely aside from any consideration of the conservation of our natural resources, the treatment of ties is warranted by the actual savings effected. For this reason, his paper should prove a decided stimulus to further and more universal treatment. At the same time too much dependence cannot be placed on treatment alone. Mr. Ray very properly emphasized the care taken on his road to secure ties of the proper size and quality, and also to protect these ties against unnecessary mechanical injury after treatment by means of tie plates of adequate size, etc. It is in these features that not a few roads that are using treated ties extensively are falling short. Particularly in the selection of ties for treatment, to insure that they are of proper sizes and are free from decay, is negligence evident in many

localities. Equally prominent are the shortcomings of many roads in failing to conserve the investment that they have made in the treatment of their ties by protecting them against mechanical destruction.

In interpreting the Lackawanna's results they must be considered in the light of the all-around protection afforded by that road. Like the "one hoss shay," ties must be protected in all respects and not alone against decay. It is only by complete, well-balanced protection that the railways can secure the maximum life from their cross ties.

Another Step in Tie Protection

AS MORE attention has been given to the protection of cross ties against wear to make their resistance against this form of destruction equal to that provided against decay by treatment with preservatives, one of the forms of wear that has become more apparent has been that which developed at the tie plate bearing. The more general use of treated ties has led to the replacement of the deep rib plates with those having flat bottoms or shallow ribs. This has reduced the grip of the plate on the wood fibres and has in turn resulted not infrequently in the chafing of the surface of the tie under the plate, as it moved under traffic. To overcome this, one or two roads are now experimenting with wooden shims between the plate and the tie, the shim being of a wear-resisting wood and designed to take the chafing of the plate.

Another expedient designed to accomplish the same purpose is that adopted by the Pittsburgh & Lake Erie several years ago and more recently by the Delaware, Lackawanna & Western and described by G. J. Ray in his paper before the Wood Preservers' convention at Montreal—namely the fastening of the plate securely to the tie by screw spikes, independent of those holding the rail in place. By this measure, the plate is made to act as a part of the tie and all movement between the two and the subsequent wear of the tie are eliminated, the plane of motion being transferred to the bearing of the rail on the plate. This is a further step in the scientific design of the track structure, adding one more link to the chain of protection thrown about the cross tie, the most costly unit of the track structure.

What of the Mexican?

IF 100 track supervisors were asked to give their opinions concerning the classes of men employed in track work the chances are that about 90 would express their preference for the particular class which they employ in the largest numbers, or at least would favor this class as their choice second only to native white labor. There are exceptions to this rule, of course, but in general, the southerner favors the negro, the northerner speaks well of the hobo, and the man in the Southwest gives a favorable report of the Mexican, as will be noted in the "What's the Answer?" pages of this issue.

In contrast with this is the attitude of the supervisory officer toward those classes of labor of which he employs only a limited number. It is a common trait of men to disparage the ability of people with those habits and customs they are not familiar. There was a time in this country when a "Help Wanted" sign sometimes carried the subcaption, "No Irish need apply;" yet what roadmaster has not regretted the passing of the Irish track hand? The Italian was once ill-considered, but the time came when he was deemed a most desirable recruit for both section and extra-gang work and excellent material to be trained for foremen.

Legislation has effectively stemmed the free flow of European immigration which formerly served as the main source of track labor. That the railroads experienced no marked difficulties from this cause is due to remarkable economic changes that took place simultaneously, chiefly among which were the marked increase in the employment of labor saving machinery and the great reduction in the demand for farm labor. Another factor was the great increase in immigration (official and otherwise) from Mexico, and the remarkable migration of the Mexican from the Southwest into the North and East.

Until recently considered an undesirable recruit for track work, he is now seen on the tracks in places where his presence 10 years ago was undreamed of. Like anyone else, unused to our ways, his presence gives rise to problems if not serious difficulties. The resourcefulness of the maintenance of way officer is being called upon to meet a new situation.

Meeting the Emergencies

THE article on the restoration of traffic on the railroads in New England after the disastrous flood of November, which appears on page 46, pays a fitting tribute to the men who were responsible for the expedition and effectiveness of the emergency measures taken. However, it is doubtful if the men who carried out this remarkable achievement are inclined to make much of it. It was one of those things which men take as they come. Furthermore, they realize that the success which attended their efforts to restore the lines to service after the great disaster must be ascribed in large part to the fact that all of them, from section foreman to president, had been through emergencies before; they knew what had to be done and how to do it.

It is true that the damage done was much greater than had occurred in any previous flood in the same territory. It covered a much larger area and the destruction of the affected portions of the line was much more complete, but like the railroad men on other properties, they had had experience in floods or washouts of some kind before or had been concerned with emergency work from some other cause. Furthermore, it may be said that they owed their positions of responsibility in the service to some extent, at least, to the initiative and resourcefulness they had displayed in previous times of stress.

Therefore it is not surprising that the work of rehabilitating the lines was taken up at many points by various units of the organization on their own initiative while the general officers were still unaware of the true state of affairs because of the destruction of telegraph and telephone lines, a condition which in itself, imposed the necessity for conducting the initial work of restoration without any thorough coordination of the operations as a whole.

This does not imply a lack of organized effort, for the work was organized on a system basis as soon as this was possible. Indeed, what higher form of organization can be conceived than that which functions in all its units without centralized control when circumstances make this necessary? Such an organization is founded on thorough training, a careful selection of the leaders and, above all, a loyalty that forgets hardships, long hours and fatigue when the occasion demands.

New England Railroads Restore

Wreckage on a Boston & Albany Bridge East of Becket, Mass.

WORKING under the severe handicaps of long hours, cold, rain and fatigue, but with their morale and spirits undaunted, the forces engaged in restoring the railroads in New England after the disastrous floods of November 3, 4 and 5, made such remarkable progress as to attract the most favorable comment from shippers and the general public. So effectively was the work planned and carried out, that within a week's time the Boston & Maine, for example, had restored about 650 miles of its lines to service. The Boston & Albany had one of its tracks in full service by November 15 and both of its tracks in service by November 30. Similar records were accomplished on the other roads affected, one of the most outstanding being that of the Central Vermont, which in spite of its almost complete destruction and the handicaps of the receivership into which it was thrown, is expected to be restored throughout for local service by the first of February.

Extent of the Damage Done

To describe in detail the extensive destruction sustained by the New England roads, and to give a clear and complete picture of the situation which confronted them, is impossible. Therefore only a brief summary will be made of the damage sustained by the four roads most seriously affected, and of some of the methods used in their rehabilitation. On the Boston & Maine, the largest road affected, 946 miles of lines out of a total of 2,082 miles was put out of service. Within this extensive mileage 64 miles was under water, 27.03 miles was washed to a depth from 1 to over 20 ft., 5.6 miles was undermined by roadbed slips, 7.2 miles was washed off the roadbed, and 1.3 miles was washed completely off the right-of-way. In addition, the ballast was completely washed away over a distance of about 10 miles. This aggregated 51.8 miles of tracks on the B. & M. which required almost complete reconstruction.

In addition to the damage to the roadway, 17 bridges required complete rebuilding, 13 bridge superstructures had to be relined on abutments and piers, 48 abutments and piers required underpinning or repairs, 28 culverts were washed out and had to be renewed, 10 buildings were moved from their foundations, 68 signals were destroyed or required repairs, and 15 water stations and three turntables were damaged.

On the Boston & Albany, with its 404 miles of lines, 56 miles were put out of service temporarily by the flood. Of this mileage approximately 3.3 miles were damaged seriously by washouts and slides, and by the destruction of five bridges.

Rutland Almost Completely Tied Up

On the 413 miles of the Rutland, which was almost completely tied up by the flood, there were 356 washouts and slips, ranging from 2 ft. to 70 ft. in depth and covering a total track length of 90,772 ft. In addition to the washouts, there were 40 more or less severe landslides which affected 5,575 lin. ft. of track, and required the removal of approximately 10,000 cu. yd.

Washout of B. & M. Bridge at Bellows Falls, Vt.

Flood-Wrecked Lines to Service

An Insight into the Damage Sustained and an Account of the Measures Employed and Materials Used in the Work of Rehabilitating the Lines

Conditions at Another Bridge Near-by.

of material. Damage to bridges on this road was confined to 10 structures, most of the damage being sustained by the abutments.

The most complete loss resulting from the flood was that sustained by the Central Vermont on about 45 miles of main line and 54 miles of branch lines. Here the damage was so complete that it was two weeks before it was possible to make more than a rough estimate of the losses which had been sustained. So violent was the action of the flood water in some locations that long stretches of track were carried away and turned over as many as four times before they came to rest far from the roadbed. The maximum depth of washouts on this road was 80 ft., and the maximum length approximately 4,400 ft. Forty-one main line bridges suffered damage entailing expenditures for restoration ranging from $500 to $150,000 each. Nine bridge superstructures were entirely washed away, the most important of these being a two-span, deck-truss bridge 300 ft. long over the White river at Sharon, Vt.

Difficulties of Rehabilitation Work

Each road set out to restore its roadways for traffic at the earliest possible date. Cut off from communication in many instances, local forces on the roads proceeded with the repair work on their own initiative while the general officers and their staffs assembled large forces and quantities of material in anticipation of the needs to be ascertained when actual conditions became known. As soon as communication was possible, all work was thoroughly co-ordinated and men and materials were rushed to the points most urgently in need of them.

Same Location a Short Time Later

The initial activities were centered on the restoration of through service on the main lines. Depending upon whether they were single or double track and the accessibility of the damaged sections, the roads of necessity attacked the work confronting them along different lines. In single-track territory, traffic was restored in many instances by repairing sections of one track or the other where the damage was the least severe and connecting up these sections to the best advantage, leaving the heavier work on the remaining trackage to be carried out after single-track service was restored. The prosecution of this plan by the Boston & Maine and the Boston & Albany accounts in large measure for the remarkable speed with which through service was restored on these roads.

Many other conditions affected the rehabilitation work. The destruction of an important bridge or a severe washout at each end of a long stretch of line, effectively prevented the use of work equipment over the entire intervening section of road until the gaps at the ends were filled or temporarily bridged. This situation confronted practically all of the roads, but more particularly the single-track roads remote from highways in the rugged, crooked valleys of the New England rivers. It was this predicament which caused the greatest delay in the restoration of traffic on the Boston & Albany between Washington, Vt., and Russell, a distance of about 22 miles, where destruction at the ends was so complete that it was a number of days before even the lightest equipment could be moved over the line in order to restore the roadway and bridges.

Without question, the road most seriously obstructed in this manner was the Central Vermont, on which sections of line could not be reached by heavy equipment for several weeks, while the road which was probably delayed the least by reason of this condition was the Boston & Maine, which, through its network of lines in the storm swept area, was able, in most instances, to divide its total mileage of destroyed tracks into comparatively short sections.

Regardless of the accessibility of the damaged areas,

the efforts of the roads were concentrated first on making the track sufficiently stable to carry work trains of construction equipment and materials so that work could progress at as many points as possible at the same time. Most of this work was of necessity accomplished entirely by hand. While there were heavy accumulations of heavy debris over large stretches of all the tracks in the flooded area, possibly the most extensive accumulation, completely blocking the roadway, was in the three-mile stretch on the Boston & Albany east of Becket. Within this territory uprooted trees were jammed in the wreckage, together with the girders of several bridges to a height of from 10 to 15 ft. All of this debris had to be removed by hand, piece by piece, aided in some cases by the use of explosives.

Slides in cuts or along hillsides were common on all of the roads, and numerous instances may be cited on each of them where it was necessary to remove several thousand yards of material in single slides to provide only sufficient clearance to permit the passage of a work train. Other work required in many cases was that of pulling the tracks back on to the roadbed, and blocking, cribbing and filling the tracks by hand to restore them to a degree that would permit the passage of light grading equipment. This was expedited in some places by the building of shoo-flies, but in some places permanent relocations were found necessary.

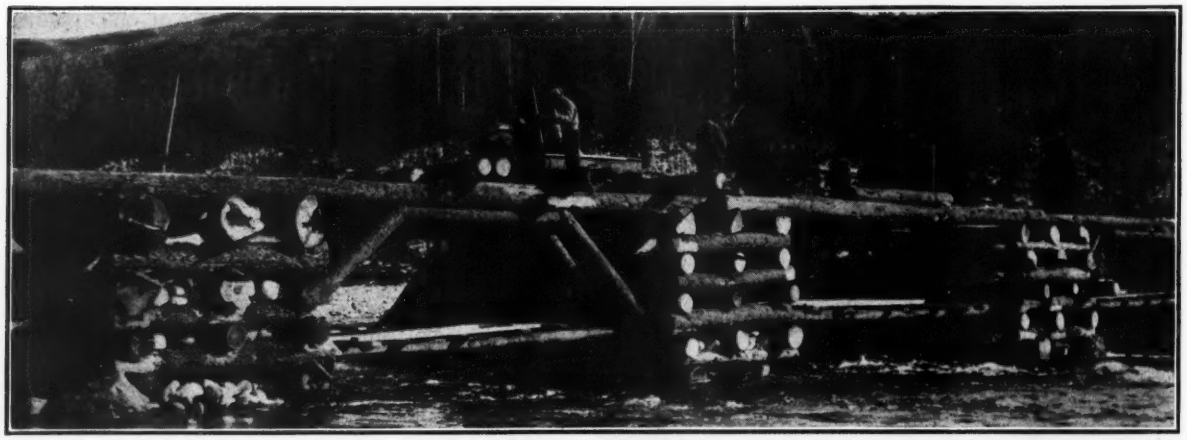
How the Work Was Organized

The methods employed in the rehabilitation, necessarily varied with local conditions. In general, however, the practice put into effect on the Central Vermont had its counterpart in the work of the other lines. Under this plan, the organization was divided into three distinct parts. The first unit consisted of a large force of men who removed debris from the roadway and bridges, smoothed up the subgrade or ballast where possible, and pulled the track back on to the roadbed. The amount of this work varied, of course, with the extent of the damage, being relatively light at some points, as the purpose of this advance organization was merely to prepare for the passage of light grading equipment. At hundreds of other points, this class of work was most extensive, particularly where debris and heavy slides were encountered, and where for thousands of feet the track had been washed completely off the right-of-way and in many instances overturned.

On the Central Vermont, where the extent of the destruction made it evident that rehabilitation work would extend well into the winter, another important item entered into the work of the advance organization. This was to raise and block up all displaced track and clean it thoroughly, so that when freezing weather set in, there would be no difficulty and delay in digging it out. This precaution was a wise one, as much of the track was not restored to place until after freezing weather had set in.

New Alinement, a 180-ft. Trestle, and 15,000 cu. yd. of Fill Remedied this 670-ft. Washout on the Rutland, Near Proctor, Vt.

With the tracks made passable, the second unit of the Central Vermont's organization consisted of work train crews with light power, and generally with small-capacity dump cars, which were employed to make the shallower fills and strengthen the roadbed sufficiently to carry the heavier grading and bridge construction equipment. The third unit of the organization was made up of heavy construction equipment which was then used continuously to put the lines back into operating condition.



Unusual Timber Crib Trestle on the B. & M. at North Woodstock, N. H.

Methods Employed Varied Widely

The methods pursued in blocking and cribbing the washed tracks varied widely, as any available material, including ties, bridge timbers, and even timber debris was used in this work. On the Boston & Albany, particularly, a large amount of such trees and logs covering the tracks were of sufficient size to make effective cribbing, and thousands of feet of this material was used with the result that a large saving was made

in the use of sound ties and bridge timbers. All of this material was permitted to remain in the roadbed only until enough filling material had been deposited to support the track.

The Rutland employed the same character of materials for cribbing and blocking and, in addition, made extensive use of waste marble and other stone as temporary support for the tracks. In a number of instances, stone walls along the right-of-way were torn down in order to provide an adequate and readily available source of blocking material.

A variety of methods was also employed in pulling track back on the roadbed. Lines were used extensively, employing both teams and tractors for power, although man power alone was available for this work at many points. On several roads, locomotive cranes were also used effectively to some extent.

Filling Assumed Large Proportions

The filling of the miles of washouts on the New England roads was accomplished in much the same manner, using every type of open car available, including side dump cars, hopper-bottom cars, ballast cars, flat cars, and ordinary gondolas. Motor trucks were also employed in this work, although their use was confined largely to the transportation of men and materials. The unloading of the cars which were not self-dumping was accomplished principally with Lidgerwood unloaders and locomotive cranes, although large quantities of material had to be unloaded by hand where unloading equipment was not available or could not be moved over the tracks.

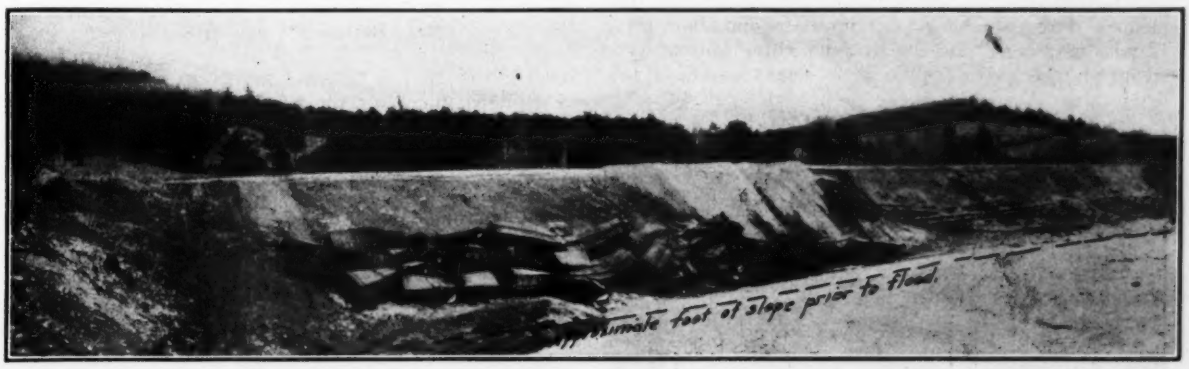
The character of the filling materials used was governed almost entirely by its availability, the B. & A. having used mostly sand, and the Rutland, the Boston & Maine and the Central Vermont, largely gravel and cinders. In most cases, new pits were opened to avoid long hauls of filling material, but on the Boston & Maine it was deemed preferable to haul hundreds of cars of filling material a distance of over 100 miles rather than to incur the delay necessary to dismantle a large capacity steam shovel and ship it to a new location.

Temporary pile trestles were necessary, of course, and many were built by all the roads. More than a mile of such trestles was constructed on the Central Vermont alone. Where both filling and trestle construction was out of the question because of the magnitude of the destruction, temporary detours or shoo-flies were built where possible. But at North Duxbury, Vt., on the Central Vermont, where the entire roadway was washed out to a depth of 40 ft. for a distance of about 4,400 ft., the line was rebuilt permanently on a new alinement.

Old Box Cars Retain High Fill

At East Clarendon the embankment was washed out for a distance of 425 ft. and to a depth of 70 ft. Here the new bank was constructed about 15 ft. east of the old location, but in spite of this, about 25,000 cu. yd. of filling was required for the new roadway. At this point, one of the most unusual expedients in the rehabilitation work was used, as 30 condemned freight cars held for dismantling, were dumped into the hole to retain the slope of the new fill. Through this expedient, thousands of filling yards of material were saved at a most critical time, and traffic was restored far in advance of the time when enough filling could have been placed to allow the material to take natural slope. After the line of the Rutland had been opened to traffic, the box cars in the East Clarendon fill were burned and the embankment widened to its final width.

An indication of the extent of embankment destruction and washouts on the various roads is indicated by the volume of grading required for restoration. The Boston & Maine moved approximately 11,115 carloads of filling material, while the Central Vermont estimates that it will require the handling of at least 1¼ million cubic yards of material in fills and cuts before through service can be re-established.



Condemned Cars Dumped Into a Deep Washout on the Rutland Saved Thousands of Yards of Fill Until After Service Was Restored

While the primary requirement was that of restoring embankments, extensive work in cuts was also necessary in a number of instances. This was the case, particularly on the Central Vermont where, at a number of points the entire roadway was lost in hillside slides. At these points the new line was established by benching further into the hill. At Blue Hill, about one mile south of Bethel, Vt., such a slide, occurring on November 4, took with it 200 ft. of the roadway. At this point a new sidehill cut involving 40,000 cu. yd. of excavation was taken out by two shovels in time to permit track to be laid, and local freight and passenger service to be restored by December 7.

Much Rip Rap Was Used

Rip rap also formed a large part of the material handled by the New England roads in rebuilding their lines, a determined effort being made to guard against a recurrence of the embankment wash experienced in the recent floods. While rip-rapping operations are by no means complete, records show that the Boston & Maine has handled 2,500 carloads of stone, the Rutland about 390 cars, with 500 cars more to be placed, the Boston & Albany 400 cars, and the Central Ver-

mont a quantity which cannot be estimated at the present time owing to uncertainty as to the magnitude of the work yet to be completed in putting this line in a permanent condition.

Bridges entirely washed out and destroyed were hurriedly replaced by pile trestles. Many plate girder spans washed from the piers and abutments were reclaimed and re-erected. Partly undermined piers and abutments were strengthened by underpinning, but in many instances it was necessary to provide temporary pile substructures. Extensive as this work was, it might have been even greater if it had not been for the fact that some of the larger bridges were saved during the flood by loading them down with loaded coal cars.

Made Extensive Use of Heavy Equipment

A large amount of heavy equipment was employed during the last three months in the work of rehabilitation. During the peak of the work on the Boston & Maine, five large steam shovels, 14 locomotive cranes, 6 American ditchers, 3 spreaders, a number of pile drivers, and several hundred ballast cars, air-dump cars and gondolas were in constant service. On the Boston & Albany, the work was accomplished with one 2½-yd. steam shovel, one bridge derrick, one pile driver, one Jordan spreader and three locomotive cranes, supplemented by a number of rail unloaders and about forty 12-yd. dump cars. On the Rutland, three railroad-type steam shovels, a caterpillar type steam shovel, a pile driver, two American ditchers, three Jordan spreaders

Roadbed Entirely Gone at Blue Hill, Vt., on the C. V. Hillside Was Benched and Local Service Restored in About Four Days.

and a considerable number of dump cars were employed, while the major equipment used by the Central Vermont included six pile drivers, four 2½-yd. steam shovels, four ¾-yd. gasoline shovels, four 25-ton locomotive cranes, six Jordan spreaders, four Lidgerwood unloaders, and about 300 side-door ballast cars. This equipment was secured from a number of sources. For example, the New York Central furnished equipment and track and bridge gangs to the Boston & Albany and the Rutland, while the Canadian National supplied the Central Vermont with practically all of the equipment used in its rehabilitation work.

The forces employed by the various roads varied in size throughout the period of restoration, the force employed on the Boston & Maine ranging from 4,000 to 5,000 men, that on the Boston & Albany ranging from 800 to 900 men, that on the Rutland from 1,000 to 1,300, and that on the Central Vermont reaching a maximum of about 2,000. These large emergency forces were made up in general by massing the section forces from unaffected territories, hiring men out of employ-

High Trestle Replacing a 125-ft. Deck Truss Washed Out Near Bethel, Va., on the C. V.

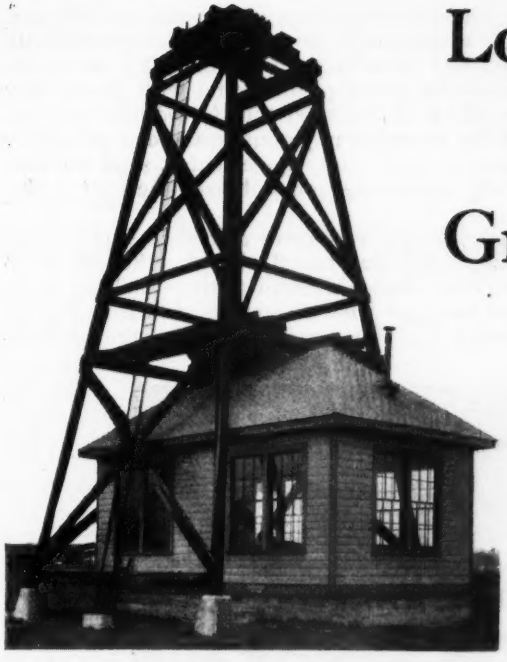
ment in the stricken districts, recruiting employees from other departments of the roads, and supplementing all of this available labor in some instances by skilled track men and bridge men secured from other roads. While complete records of the labor expended on each road are not available, it is known that on the Boston & Maine alone, over 1,000,000 man hours of additional labor were required, while on the Boston & Albany about 214,000 additional man hours were consumed.

Large Quantities of Ties and Timber

Equipment and labor were only part of the urgent requirements in the flood rehabilitation work, the other most important need being construction materials and supplies of a widely varying character. Of these, the most essential items included filling material, piling, cross ties and bridge timbers for both cribbing and trestle work. With the exception of filling material, the Boston & Maine required the greatest amount of construction materials in its rehabilitation work. Altogether it used 100,000 cross ties, 950,000 ft. b. m. of bridge timbers, and 50,000 lin. ft. of piling. The other roads also had extensive requirements, but on the Boston & Albany and the Rutland, material for cribbing and blocking was reduced to a minimum through the use of trees and logs lodged in the debris as well as large stones which were available for this work.

Purchases of piling were also held to the minimum on several of the roads, the Boston & Albany and the Central Vermont in particular, having been able to secure a large amount of this material directly from the woods immediately adjacent to where it was needed.

The supplying of the needed material when and where needed put the purchasing and stores departments of the New England roads to severe test. But these demands were met with effectiveness and dispatch. For example, on the Boston & Maine, where the stores department was called upon for a complete bill of material for a 500-ft. pile trestle at Hoosac Junction, Mass., a requisition was placed at 8 p. m. on November 3, and by midnight two cars of material were under load, and were moved out on the first train. By noon the following day all of the remaining material for this trestle was on its way in a special train.



Pumping Station and Derrick for Removing Pump

Louisville & Nashville Meets Problem of Greater Water Supply

Care in Study of Underlying Strata and Selection of Strainer Results in Ample Discharge

By F. H. KORNFELD

Assistant Engineer of Water Supply, Louisville & Nashville, Louisville, Ky.

UNUSUAL care in the selection of well screens, a unique arrangement for removing the pump and completeness of the electrical control are outstanding characteristics of a water station which the Louisville & Nashville completed recently at Leewood, Tenn., its freight terminal at Memphis. This station is 7½ miles distant from the locomotive terminal and 4.7 miles from the passenger terminal, the Memphis Union station.

The switching locomotives at Leewood originally required a relatively small quantity of water which was obtained from a well and a small direct-acting steam piston pump, placed 25 ft. below the surface of the ground, which furnished approximately 40,000 gal. per day. Increasing consumption finally resulted in draughting the well to depths below those at which suction could be maintained. A direct-acting steam deep well pumping engine was, therefore, installed which delivered approximately 90,000 gal. of water per day for about six weeks when increasing quantities of sand discharged with the water indicated the failure of the strainer.

Water for locomotives was an economic necessity at Leewood. The time lost by locomotive and switching crews in return to Memphis for water, would require the employment of an additional locomotive and two additional crews. Furthermore if water was not available, locomotives delivering cars to connecting railroads were of necessity forced to obtain water from the connecting roads. The installation of mechanical facilities at Leewood for minor repairs of locomotives and freight cars was also contemplated.

The Memphis municipal water works did not serve Leewood and the probability of the extension of its pipes to that vicinity was negligible. The nearest adequate supply of surface water was Wolf river, which was usually very muddy and otherwise objectionable as a boiler water because of its scaling proclivities.

Western Tennessee lies in the Atlantic Coastal plain and ground water is abundant and usually of good quality for industrial purposes. The geologic formations, in the order of penetration when drilling wells, is as follows: alluvium, loess, Lafayette, Lagrange, Porters Creek, Ripley, Selma and probably Eutaw in the extreme southwestern part of the state. The Lafayette, Lagrange, Ripley and Eutaw usually contain water-bearing sand strata.

The Geology of the Area

Wells in the alluvium and loess furnish hard water. The Lafayette formation has been removed in places but when present and underlain by clay, the sands yield a limited supply of water, the quality of which is usually good if the well is stopped in the sand, but is frequently hard if the well penetrates the underlying clay. The Lagrange formation is the most important as a source of water supplies because of the great area which it underlies, as well as the quantity and the quality of the water which it contains. The Lagrange formation consists of strata of clay and fine-grained sand containing lenses of plastic clay and of coarser water-bearing sands. The total thickness of the Lagrange formation in the vicinity of Memphis varies between 900 and 1000 ft.

The Porters Creek formation consists largely of dark gray clay and is probably less than 200 ft. thick. The Ripley formation (east of Leewood) consists largely of fine sand interbedded with strata of clay which have been found with a thickness of 20 ft. The total thickness of the Ripley formation in the vicinity of Memphis is believed to be approximately 500 ft. The thickness of the Selma and the Eutaw formations can only be estimated from their thicknesses farther east where they occur at the surface or at comparatively shallow depths. Wells have never been drilled through the Ripley formation at Memphis but one is now being drilled which is believed to have penetrated it to a depth of 300 ft. without encountering sands sufficiently coarse to provide water in quantities great enough to warrant the expense of pumping.

Of the many wells drilled in the vicinity of Memphis, probably 80 per cent were successful and 95 per

cent of the successful wells terminated in the Lagrange formation at depths less than 500 ft. The probability of obtaining water from wells drilled less than 500 ft. in depth was, therefore, between 70 and 80 per cent.

The Sand Was Studied

The well at Leewood previously mentioned was drilled in 1917 and is 424 ft. deep. A 10-in. wrought steel casing extends to a depth of 398 ft. A brass tube well strainer of 9½ in. external diameter and 32 ft. long, with the lower 26 ft. exposed to water-bearing sand, forms the lower part of the well. The strainer openings are 0.006 in. wide. A coarse water-bearing sand was penetrated to a depth of 41 ft., but failure to withdraw the wrought steel casing and expose the maximum length of the strainer to coarse water-bearing sand was believed responsible for the early failure of the strainer. The log of the well, as reported by the well driller, is shown in sketch "a," Fig. 1.

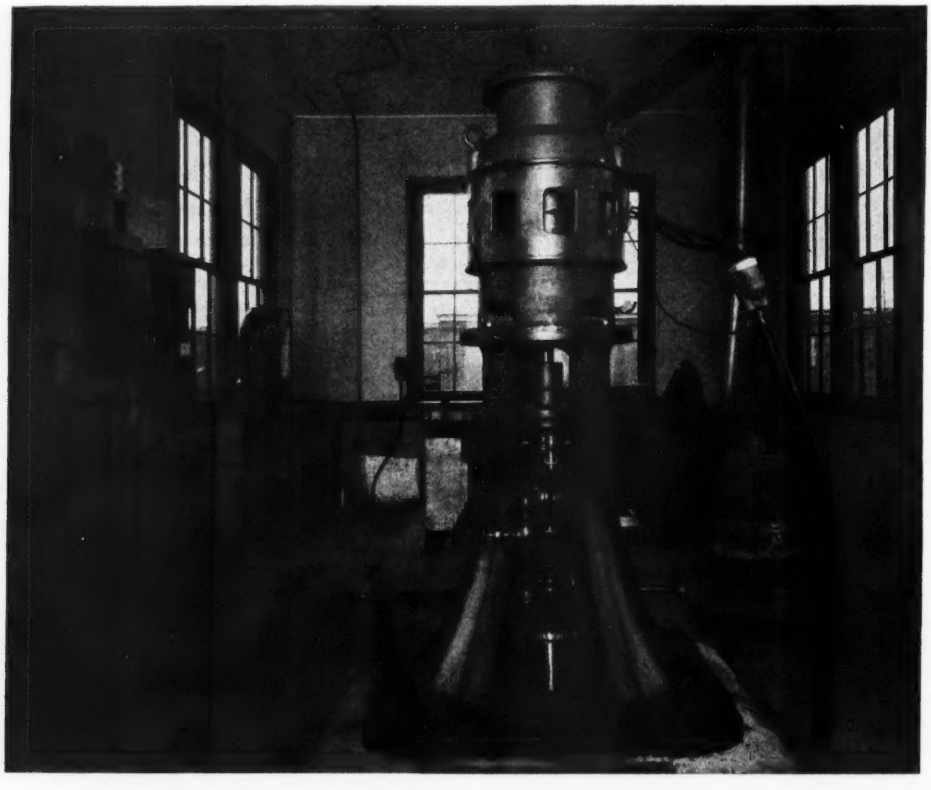
A 6-in. test well was drilled approximately 300 ft. from the well drilled in 1917, the log of which, as reported by the well driller, is shown in sketch "b," Fig. 1. Examination of the cuttings indicated that the well strainer openings would probably be between 0.006 and 0.012 in. Failure of the strainer of the first well at comparatively low yields induced the adoption of a 12-in. strainer.

The well was completed by reaming the test hole with a rotary bit that enlarged the hole to approximately 19 in. in diameter to a depth of 110 ft. A 16-in. casing was placed to that depth and reaming continued with a bit that enlarged the hole to approximately 15 in. in diameter. The wash water which removed the cuttings was a mixture of water and clay which could be pumped through the drill pipe and bits without great difficulty by means of a direct-acting steam piston pump with special pot valves. Much of the water thus forced into the hole entered the surrounding porous strata, depositing the clay carried, until the clay-cemented sand became practically impervious and stabilized the wall of the hole.

Samples of sand were taken at various depths after the enlarged hole penetrated what was thought to be water-bearing sand. Mechanical sieve analyses were made of the sand with the resutls shown in Fig. 2, 3, 4 and 5-A. The specifications for the strainer provided that the width of the opening should be such that a sieve or screen having equal size square openings should permit the passage of not less than 30 per cent nor more than 40 per cent of the sand sample. Proportions of the sand samples passing various size sieve openings were to be determined by weight. The analyses were to be made with sand carefully dried. Strainer openings in accordance with the specifications would have been as follows:

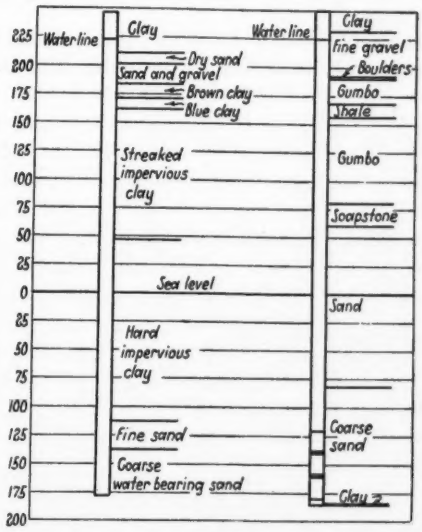
Elevations —113 to —132. Greater than 0.0092 and less than 0.0102.
Elevations —132 to —148. Greater than 0.0090 and less than 0.0102.
Elevations —148 to —168. Greater than 0.0122 and less than 0.0136.
Elevations —168 to —184. Greater than 0.0130 and less than 0.0145.

At this stage, attention was called to the probability that if the sieve analyses were made under water and the proportions determined by volume (in order to simulate conditions in the well as nearly as possible) entirely different results would be obtained.



The Interior of the Pumping Station Showing the Electrical Control

The sample of sand from elevations—168 to —184, which have been analyzed, was thoroughly saturated and laboriously screened through the various sieves under water. The resultant sieve analysis is shown in Fig. 5, "b." The strainer opening permitting more than 30 per cent and less than 40 per cent (by volume) of the sand sample to pass was greater than 0.0185 and less than 0.0198.



Figures 1A and 1B—Logs of the Original Well and the Test Well

The Strainer Selected

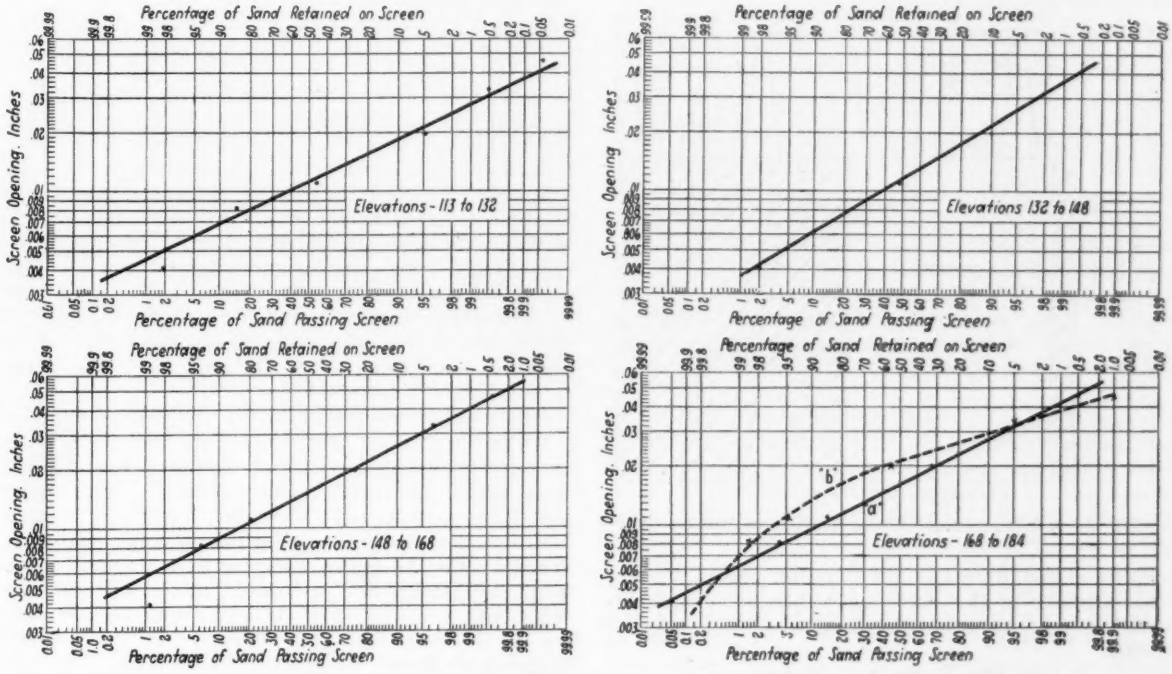
Consideration was given the fact that sand samples obtained by washing would not accurately indicate the conditions actually existing in the well. They would probably indicate a sand of finer texture than actually would be present as a greater proportion of the smaller particles would be removed by the wash water. Moreover, some of the coarser particles present would be reduced to meal and thereby introduce an additional factor indicating a fine sand. The strainer openings adopted and the effective lengths of strainer were as follows:

Elevations	Strainer Opening	Effective Lengths
—120.6 to —137.9	0.012	17 ft. 4 in.
—139.8 to —158.0	0.014	18 ft. 3 in.
—160.0 to —179.5	0.016	17 ft. 6 in.

The strainer was made by wrapping a keystone shaped bronze wire on perforated black wrought iron pipe 12 in. in diameter. The gross area of the perforations in the iron pipe was more than twice that of the strainer openings. A longitudinal cross-section of the strainer is shown in Fig. 6.

Installing the Strainer

A foot piece of a short length of pipe of the same diameter as the strainer and well casing was fastened to the lowest strainer length. The foot piece contained a simple spring-operated rubber valve similar to a pump valve, which permitted water only to pass out. The foot piece and first strainer lengths were lowered into the well and successive strainer lengths and casing lengths assembled in turn and lowered until the foot piece rested on the bottom of the drilled hole. Standard wrought iron pipe couplings were used in assembling the foot piece, strainer and casing. The annular space between the 12-in. casing and the 16-in. casing was filled with concrete.



Figures 2, 3, 4 and 5 (a and b) Mechanical Sieve Analyses of Sand Taken at Various Well Depths

The well was then "developed." Clear water was forced through the foot valve. The lowest portion of the strainer, about four feet in length, was then alternately flushed with clear water and pumped by means of compressed air. Packed heads fitting inside the strainer and outside a three-inch flush joint pipe limited the portion of the strainer which was alternately flushed and pumped. As the clay-cemented sand wall of the well opposite that portion of the strainer limited by the packed heads within

the strainer, disintegrated, the clay was pumped out with the water. When comparatively clear water was obtained from the limited length of strainer, the packed heads were raised two or three feet and the operation continued. After the entire strainer length had thus been flushed and pumped, the packed heads and pipe were removed and the foot valve sealed with concrete. The top of the well was then capped, pending the construction of the pump house and the installation of the deep well pump.

House Designed for Quick Removal of Pump

A frame pump house was constructed in which the monitor was designed of such shape as to permit the easy insertion and removal of the pump discharge sections of a maximum length of 22 ft. An opening was provided in the roof separate from the monitor for the fall line of a hoist.

In order to lessen the probability of a serious interruption to the water supply without providing two wells and pumps, a derrick was erected and an electrically-operated hoist was installed by means of which the pump can be removed and replaced in three hours. The hoist is rated at four tons capacity with a rope speed of 35 ft. per minute. The capacity of the hoisting drum is 200 ft. of ¾ in. rope in a single layer. The derrick is surmounted with a "crown block" having three 24-in. cast iron sheaves, staggered to prevent twisting of a five-part line. The two extra sheaves and a heavy two-sheave block with a swiveling hook were provided for the possible ne-

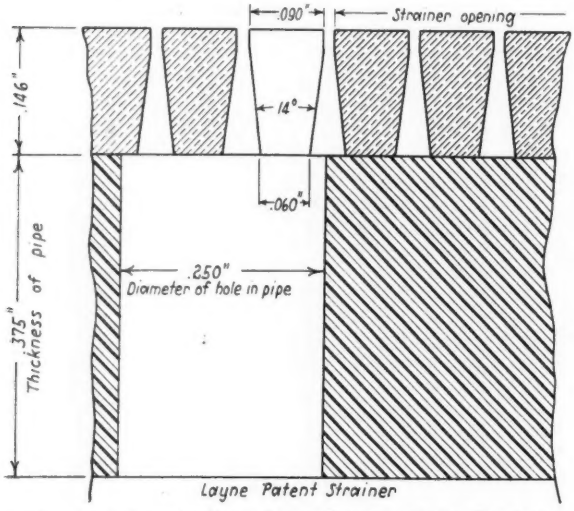


Fig. 6—A Longitudinal Cross Section of the Strainer

cessity of installing a smaller strainer within the original strainer in the event of failure. A single line only is employed in installing and removing the pump.

The Pump and Motors

A three-stage centrifugal deep well pump with a casting having an outside diameter of 15 in. was installed. The pump was suspended on a 7-in. wrought iron pipe, which serves as the discharge pipe, and was driven by a 1½ in. high carbon steel shaft enclosed in a 2½ in. wrought iron oil tubing concentric with the 7 in. pipe. The pump rotates at a speed of 1170 revolutions per minute.

The pump discharges into a tank against a maximum pressure of 21 lb. per sq. in. An air valve was placed on the tank supply pipe between the pump and a check valve in order to "break" the vacuum produced by the column of water in the pump discharge pipe, when the pump is stopped. This permits the water in the discharge pipe of the pump to return into the well with an appreciable velocity. The "surge" produced in the well is deemed beneficial as tending to agitate the sand in close proximity to the strainer.

A recording Venturi meter in the tank supply pipe records the rate and time of pumping, and the total quantity of water pumped. Daily records of power consumed are obtained from an integrating wattmeter and transcribed on the reverse side of the Venturi meter record cards. A periodic check of pump performance was thereby facilitated.

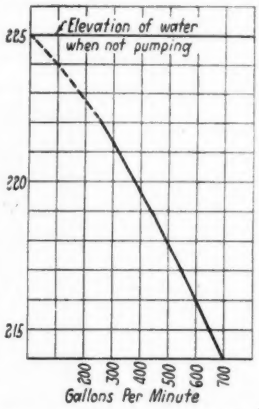


Fig. 7—The "Drought" of the Well for Various Rates of Pumping

The pump is driven by means of a vertical squirrel cage induction motor direct-connected to the pump shaft. The motor starter is a full magnetic automatic starting compensator controlled at will by either push button or float switch. The original installation provided a pressure switch instead of a float switch but difficulty in adjusting its contacts for accuracy in stopping the pump when the waterlevel in the tank reached a predetermined elevation led to the adoption of a switch controlled by a float.

In order to observe the operation of the pump and to familiarize the attendants with the operation of the equipment, several tests were made to determine the pump characteristics and the capacity of the well. The tests involved the careful measurement of the power consumed by the motor, the elevation of the water in the well at different rates of pumping, observations of the rate of pumping on the Venturi meter scale and on a weir when the pumping rate exceeded the capacity of the Venturi meter, and observations of the head pumped against. The curve showing the "drought" of the well at various rates of pumping is shown in Fig. 7.

The equipment utilized in the installation includes a Layne three-stage centrifugal deep-well pump with an outside diameter of 15 in. equipped with Kingsbury thrust bearings, manufactured by the Layne and Bowler Company, Memphis, Tenn.; an American four-ton single-line elevator engine, manufactured by the American Elevator and Machine Company, Louisville, Ky.; a Venturi meter with an 8-in. inlet, and a 4-in. throat, recording gallons per minute on 24-hour charts, manufactured by the Simplex Valve and Meter Company, Philadelphia, Pa., and a three-phase 60-cycle, 220-volt, 30 hp., 1,200 r.p.m. squirrel cage induction motor and a three-phase, 60-cycle, 220-volt, 15 hp., 900 r.p.m. wound rotor induction motor which, with the controllers and safety switches were manufactured by the General Electric Company, Schenectady, N. Y. The well was drilled and the pump was installed by the Layne-Central Company, Memphis, Tennessee, while the electrical equipment was installed by the Tri-State Armature Works, Memphis, Tennessee. The pump house and derrick were erected by bridge and building forces of the railroad.

"Users'" Day Stimulates Interest in Wood Preservers' Convention

Innovation Increases Value of Program to Railways and Other Consumers of Treated Timber

INCREASED recognition of the interest of the user of treated timber, in contrast to the more technical problems of plant operation, characterized the twenty-fourth annual convention of the American Wood Preservers' convention which was held in Montreal, Que., on January 24-26. Wednesday's session was devoted exclusively to the consideration of the service rendered by treated timber. At this session George J. Ray, chief engineer of the Delaware, Lackawanna & Western, presented a paper on "What the Lackawanna Has Gained from the Treatment of Ties," while Earl Stimson, chief engineer of maintenance, Baltimore & Ohio, spoke on the "Economy of Framing Structural Timbers Before Treatment." The sessions were presided over by O. C. Steinmayer, superintendent timber preservation, Canada Creosoting Company, Montreal, Que.

A special feature of the convention was the annual dinner on Wednesday evening. Lord Shaughnessy, a director of the Canadian Pacific, presided as toastmaster and Sir Henry Thornton, chairman and president of the Canadian National, presented the principal address. Both speakers traced the development of timber preservation practices in Canada and emphasized its importance to the future prosperity of the country. This subject was also covered in some detail at the opening session of the convention by Hon. Charles Stewart, minister of the interior for Canada.

The following officers were elected for the ensuing year: President, H. R. Condon, general manager American Mond Nickel Company, Pittsburgh, Pa.; first vice-president, H. E. Horrocks, manager Pacific Creosoting Company, Seattle, Wash.; second vice-president, C. C. Cook, maintenance engineer, Baltimore & Ohio, Baltimore, Md.; secretary-treasurer, H. L. Dawson, Chicago; members executive committee, R. S. Belcher, manager treating plants, Atchison, Topeka & Santa Fe, Topeka, Kans.; and D. C. Jones, general superintendent Ayer & Lord Tie Co., Chicago. Louisville, Ky., was selected as the place for the next annual convention.

Report on Boiling Treatments

The first use of the Boulton or boiling process for the seasoning of timber in this country appears to have been on the Pacific coast where it was found that temperatures commonly used in steam seasoning often seriously injured Douglas fir. The Southern Pacific first used this process in 1892 at its Oakland plant and later made it standard for creosoting at all of its Pacific Coast plants. The use of this process for seasoning species other than Douglas fir is, however, comparatively recent. Because of the increasing interest in this process a report was presented on recent developments in its use by a committee of which J. D. MacLean, engineer in forest products, U. S. Forest Products Laboratory, Madison, Wis., was chairman.

In this report it was pointed out that the process has a distinct advantage over steam seasoning for woods which are particularly susceptible to injury from high temperatures. Those who have had experience in steaming green red oak are aware of the severe checking and splitting that generally occur in timbers of this species when an attempt is made to season them by the ordinary steaming process. Much of this difficulty seems to be overcome when oak is seasoned by the Boulton method.

During the past two or three years a considerable amount of red oak has been seasoned by boiling under vacuum with apparent success. Red oak seasoned by this process has been in service from two to three years and appears to be in as good condition as similar material air-seasoned before treatment.

The Boulton process was first used by the Pennsylvania during the latter part of 1925 when an urgent demand for creosoted oak timbers of various sizes exceeded the available supply of air-seasoned stock and rendered the treatment of green material imperative. During the past two years the use of this process on this road has been confined almost entirely to the treatment of timber for emergency requirements.

In general, the results obtained by this road were satisfactory. Red oak timbers, comprising the bulk of the stock which has been artificially seasoned, show very uniform and deep penetration. With the exception of occasional timbers, the amount of checking which occurs during treatment is less than that normally found in similar stock which has been air-seasoned. To properly air-season such timbers would require from 15 to 18 months. A net retention of 11 lb. per cu. ft. was specified in the oak treatments.

The fact that seasoning by the Boulton process can be accomplished at considerably lower temperatures than when the steaming and vacuum method is used is an advantage of great importance. Long continued high temperatures not only affect the strength of wood, but in the case of a number of commercial species cause severe checking and collapse, notably in such woods as the oaks and refractory conifers like Douglas fir. Results indicate that a considerably greater quantity of moisture can be removed from green wood by the boiling process than by steam seasoning. It has been shown from experiments that an appreciable amount of moisture is absorbed during the steaming period and in normal steaming practice only a relatively small quantity of water is ultimately removed.

Relative Merits of Different Preservatives

The question often arises, particularly in some new preservative, as to how that material compares with other materials. In discussing the need for some simple test by which this information could be obtained, E. Bateman, chemist in forest products,

U. S. Forest Products Laboratory, Madison, Wis., pointed out that a single simple test of this character was not available, but that as far back as 1912 the Forest Products Laboratory, in a paper by H. F. Weiss, laid down the requirements for a wood preservative as follows:

1. It must be able to kill or to inhibit the organism against which protection is desired.
2. It must not attack the wood.
3. It must not attack steel.
4. It must be easy to inject into wood.
5. Once injected it must possess some degree of permanence.
6. It should be available in relatively large quantities and must be cheap.

No one of these requirements can be called of any greater importance than any other since a marked deficiency in any one of them may render an otherwise good material of little value for wood-preserving purposes.

In general, it may be said that we know less about permanence and the factors that govern it than about any other factor by which we judge wood preservatives. At the present time our research work is confined entirely to the fundamental ground work which underlies permanence and many other problems, which at first sight are only distantly related to it. Meanwhile, service tests will continue to be our criterion of preserving efficiency. We have many test tracks, test pole lines, and test fences scattered over the country. Excellent as many of these are, there is still room for improvement, both in the completeness of the data and in the manner of inspection, if we are going to compare the efficiency of preservatives. Many, if not the major portion, of our test ties are being removed because of mechanical destruction such as rail cutting, spike killing, checking and plate cutting. Ties are often cut below the treated zone. Decay then starts in the untreated heart and the tie is removed on "account of decay" or wear and decay. The question that must be answered before a true comparison can be made is, "Which came first, the wear or the decay?"

Treatment of Refractory Woods

During the last few years the Forest Products Laboratory has conducted a large amount of experimental work on the relations of temperature, viscosity and pressure to the absorption and penetration of preservative oils and zinc chloride solutions in refractory woods. During the past year investigations have been made on the injection of coal tar creosote and a three-per cent solution of zinc chloride to determine the effects of pressure, temperature and treating period on the penetration and absorption of zinc chloride solution into (1) sawed, air-seasoned mountain Douglas fir ties; (2) air-seasoned eastern hemlock ties; and (3) hewed and sawed air-seasoned cork bark fir ties. Tests were also made to determine the relative penetration of coal tar creosote and zinc chloride solution.

These tests, which were described in a second paper by Mr. McLean, showed the following results:

Mountain Douglas fir is apparently much more resistant to penetration than coast Douglas fir, but on the other hand it seems to withstand high treating pressures better than the latter species. Both the mountain Douglas and cork bark fir were found much more resistant to penetration than the eastern hemlock.

In these experiments unit change of solution temperature, within the range used, was more effective in increasing penetration than unit change of pressure. This corroborates the results of experiments described in previous papers.

The effect of raising the treating pressure was far greater at high preservative temperatures than at low.

The treating temperature, treating period, and treating pressure are evidently important factors affecting the kickback. Since the magnitude of these variables depends on the method of treatment, the net absorption may vary widely for the same gross absorption. The gross obsorption, for this reason, is a better criterion of penetration than the net absorption.

Zinc chloride solution penetrates the firs and hemlock tested much better than creosote, under the same conditions of treatment. This substantiates the results obtained in similar treatments on other species.

Other Papers and Reports

A number of years ago the association began the compilation of statistics of tie renewals on a number of railways in the hope that it might be possible to establish a definite relationship between the number of treated ties inserted in track from year to year and the tie renewals in subsequent years. After extended study and analysis, the Committee on Tie Service Records has decided that it is impossible to develop such a relationship because of the fact that the number of ties removed per mile in any year depends upon a number of factors, the more important of which are the proportions of treated and untreated ties laid each year, the kind of treatment given the ties, the amount of timber used, the character of track construction, the density of traffic, the character of maintenance and the degree of approach to the normal age limit of the treated ties. With this report the committee submitted the tie renewal records of 26 railroads showing average renewals for five-year periods, ranging from a minimum of 90 ties per track mile to a maximum of 299.

Two unusual cases of failure of treated ties were described in a paper presented by Galen Wood, consulting chemical engineer, Philadelphia. In one instance a large number of treated and untreated chestnut, oak and pine ties in the tracks of an electric railway along the Atlantic seaboard failed in three or four years because of a breaking-down of the wood under the tie plates and around the spikes, the timber being sound elsewhere. These ties were laid in a track in a salt marsh which was submerged during periods of very high tides. Investigation showed that this timber was disintegrating by reason of caustic soda, resulting from the passage of the electricity through the rails and spikes in the sodium chloride saturated ties. In the second instance, an experimental installation of ties treated with sodium fluoride in a test track in the southwest showed evidences of decay below the ballast line, although sound elsewhere, whereas ties treated with zinc chloride were standing up satisfactorily. Investigation showed that these ties were installed in limestone ballast which, with the moisture present, changed the sodium fluoride to a non-toxic material, permitting decay, demonstrating that ties treated with sodium fluoride should not be placed in service in tracks ballasted with limestone.

The Committee on Plant Operation, of which Ed Kelly, assistant manager treating plants, Atchison, Topeka & Santa Fe, was chairman, presented a report recommending that tie handlers be given more con-

tinuous employment, thereby making it possible to hold better men at lower wages and effecting a reduction in plant operating costs. This can be done only by securing a more uniform rate of production and delivery of ties to the treating plant. The committee also pointed out that the more uniform production of ties will also result in more uniform seasoning and enable a plant to reduce losses due to decay.

A committee, of which James T. St. Clair, engineer of car construction of the Atchison, Topeka & Santa Fe was chairman, presented a report on the extent to which it is practical to treat timber entering into car construction to increase its resistance to decay. This report was based on an analysis of the cost of repairing 5,925 cars during a period of 15 months in which $320,487.35 was expended on 4,214 cars for material and for the labor of removing and replacing lumber that had decayed. It showed that decay is most prevalent in stock cars. It also showed what details of car construction are most subject to decay.

Among other papers presented were one on Chemical Reactions of Wood Rotting Fungi by L. P. Curtin and another on Weathering and Field Tests of Treated Wood by P. J. Howe, chemist and construction engineer, respectively, of the Western Union Telegraph Company, describing experimental investigations of new wood preservatives leading to the development of zinc meta-arsenite which has been adopted by that company for the treatment of its poles. The Committee on the Treatment of Fir Lumber presented specifications for the preservative treatment of Douglas fir lumber by pressure process.

Framing Structural Timbers Before Treatment*

By EARL STIMSON
Chief Engineer Maintenance, Baltimore & Ohio

IN THE consideration of this subject, two phases present themselves: (1) the economies derived from the longer service life of timbers that have been framed before treatment and are therefore thoroughly protected by the treatment; and (2) the possible economies to be derived from the savings in labor made by framing the timbers by machinery before treatment at the treating plant. The first may be considered indirect or ultimate economies. The second are direct and immediate. These last are of most interest to the maintenance engineer as he is called upon to effect economies that will reduce expenses this year, not 20 years hence. The ultimate economies resulting from the increase in service life, however, will come along very nicely to help out our successors, who no doubt will be confronted with the necessity of making a showing after our exhaustive efforts.

All Exposed Timber Should Be Treated

It is universally conceded that all timber used for structural purposes, that is exposed to conditions that produce decay, should be given preservative treatment. This includes all timbers used in bridge and trestle construction and some used in building and platform work. Adequate treatment costs considerable. To realize the maximum returns, great care must be used in protecting the timber, both before and after treatment.

Before treatment the timber should be carefully piled in a well-drained storage yard, in such a way that the area of contact between the pieces will be the minimum and that there will be sufficient air space between them to permit free circulation of air, this to insure thorough air seasoning. After treatment nothing should be done to the timbers that will penetrate the heavily treated outer zone and expose the lighter treated interior. To prevent this it has become a well-established practice to adze and bore cross-ties before treatment, and, with better reason, all bridge ties and timbers should be framed, sized or cut to lengths, as the case may be, before treatment. In other words, they should be pre-framed.

This is good from the timber preservation standpoint, as the timber goes into the structure perfectly protected by a heavily treated surface and is not left exposed to decay where framed, bored or cut.

Framing at Central Point Economical

This pre-framing in itself has a very strong appeal from an economic standpoint. There is probably no more awkward and expensive operation than the framing of bridge ties and timbers in the field. It is generally done at the bridge site by the crudest methods of handling, and with hand tools, with a considerable waste in cutting. Much of the work is necessarily done in unfavorable weather, which, on account of the nature of the work and the usually exposed location where it is done, further increases its costliness. There has been ample excuse for this in the past, but this is the day of machinery and the trend of the times is to let the machine do it. This generally resolves itself into a centralization of effort and mass production, which are the fundamentals of economy.

The treating of the timbers requires that a large stock be concentrated at the treating plant for seasoning. Obviously, then, the timbers should be framed at the plant. This gives the opportunity to centralize the framing of all timbers required for a railroad, or, if a large one, a designated part of it, at the treating plant, and justifies the building of a sawing and framing mill.

Such a mill should be equipped to cut to length and gain bridge ties and guard rails, cut to length posts, caps and sills, plane to thickness, caps, stringers and trestle ties, and cut bevel ties from blanks. This will require the following machines:

Cut-off saw, 40 in., 20 hp. motor drive.
Table ripping saw, 36 in., 30 hp. motor drive.
Gainer, 8 in. head, 40 hp. motor drive.
Adjustable swing parallel saw, with dado head, for rivet grooving.
Swing arm boring machine.

*From a paper presented before the convention of the American Wood Preservers' Association at Montreal, Que., on January 25.

Planer with four heads to take timbers of a maximum size of 14 in. by 20 in., 75 hp. motor drive.
Carriage sawmill, 48 in. friction feed, 30 hp. motor drive.
Portable electric boring machines.
Pneumatic shaving and sawdust collection system.

Such a mill, housed in a light, all-steel building, will cost about $40,000.

The writer built such a mill at the treating plant owned and operated by the railroad with which he is connected. All machines are motor driven. The current is furnished from the power plant of the treating plant. As several of the machines were released by the motive power department and were taken over at a depreciated value, the actual cost of the mill was $32,290.

This mill was started in full operation in January, 1925. The output for the year 1927 was:

Bridge ties	22,163 pcs.	1,805,255 ft. B.M.
Trestle ties	12,653 pcs.	608,600 ft. B.M.
Guard rail timbers	2,138 pcs.	151,811 ft. B.M.
Caps	2,184 pcs.	378,396 ft. B.M.
Stringers	5,593 pcs.	1,605,082 ft. B.M.
Miscellaneous	14,193 pcs.	589,151 ft. B.M.
	58,924 pcs.	5,138,295 ft. B.M.

The Cost of Power Framing

The cost of framing the bridge ties and guard rail, including all charges, both operating and fixed, was $5.74 per M. ft. B.M. as compared with $16 per thousand when done by hand. The cost of sizing the trestle ties and timbers, that is cutting to length and planing to thickness, was $3.42 per thousand ft. B.M., as compared with $7 additional cost if bought sized to thickness. The miscellaneous items cost $6.03 per thousand, with a saving of about 50 per cent. On this basis the total savings effected in 1927 by handling the timbers through the mill, as compared with the method of hand work along the line of road, amount to $31,000, or very nearly a 100 per cent return on the $32,290 invested in the mill.

This mill has now been in operation for three years. Each year the output has been increased, the scope of the work extended, and the unit costs decreased. The value of the increased life of the treated timber that accrues from pre-framing, can at best only be estimated, but the savings made by the machine method of framing are subject to exact determination, as in the instance just given. In this instance no special effort was made to make a record.

Pre-Framing Also Protects Treatment

There is no doubt that the framing and boring of timbers after treatment may expose the lighter treated interior or even extend to where the preservatives have not penetrated, and render such parts vulnerable to decay. I can find no records of the effect of such conditions on the service life of timbers, nor does my own experience furnish any. For example, it may be assumed that well-treated pre-framed timber has a service life of 25 years, and that on account of framing and boring after treatment, decay attacks the exposed untreated interior and causes failure of the timber after 18 years' service. There is then a loss of 7 years' service. The cost of the timber in the structure is taken at $105 per thousand ft. B.M. By the usual formula the annual cost for 18 years' life is found to be $9.70 and for 25 years' life it is $8.21. Pre-framing, therefore, saves $1.49 in annual cost or $37.25 during the 25-year service life of the timber.

This, no doubt, is an extreme example and the average is probably much less. Much of the timber is so thoroughly treated that the framing after treatment has no harmful effect. The framing on the ties, guard rails, caps and stringers is on the underside of the timbers, and the untreated wood, if exposed, is somewhat protected. While the benefits to the timber from pre-framing may, therefore, be somewhat minimized, pre-framing may still be considered good insurance and the best of practice.

Pre-Framing Is Practical

When it was proposed to frame all bridge ties and timbers at a central plant, disastrous results were prophesied, and it was said that it could not be done successfully. This, however, has not proved to be the case.

Much of the framing is of timbers of standard dimensions, and requires no special information or plan for framing. This refers particularly to such items as trestle ties which are cut standard length and sized to uniform thickness and are not dapped, the sizing of stringers and caps, and the framing of guard rails and standard bridge ties with daps of uniform width and depth.

For other than standard timbers it is necessary to furnish the mill with framing plans, giving the dimensions in detail. This becomes somewhat complicated on the longer deck girder spans, with the varying number of cover plates. When the bridge is on a curve, the problem becomes still more interesting. The framing plans for timbers as designed for renewing existing decks are made up on the divisions from measurements taken in the field. For new bridges and for the more complicated renewals, special framing plans are made up by the bridge engineer. When ties of several different framings are required on a bridge, the ties are numbered on the plan, and these numbers are stamped on the ends of the corresponding ties for identification when placing them on the bridge. It is remarkable how few misfits are found, and these are more often found to be the result of mistakes in the framing plans than in the mill.

Almost All Structural Timber Can Be Pre-Framed

There is no reason why practically all of the timbers used in structural work cannot be framed in the mill and sent out for erection in the field, following the same practice used in building steel structures, of fabricating the members in the shop, leaving only the erection to be done in the field. We are doing this at our plant. Only recently a complete bill of framed and treated timbers, amounting to 220,000 ft. B.M., was sent out for a trestle 936 ft. long, with the result that the framing in the field was entirely eliminated. We are now about to frame and treat the timbers for a double track, three truss float bridge of the Howe truss type, 103 ft. in length.

Doing this work at a well-equipped mill not only saves in labor costs, but results in a better job, saves waste in cutting, and reduces the weight and bulk of the timber to be handled to a minimum, which latter effects a saving in the cost of handling and in freight. There is also a considerable indirect saving through the more effective control of the timber stock by having it concentrated at the treating plant where it can be cared for properly, kept within the bounds of the actual requirements, and is available for a wider range of distribution. This makes it possible to carry a smaller timber stock, with a large reduction of waste, than when the stock is scattered along the road.

Care of Ties Pays Large Returns on the Lackawanna*

An Analysis of the Results Secured from a Comprehensive Program of Protection Against Decay and Mechanical Injury

By GEORGE J. RAY
Chief Engineer, Delaware, Lackawanna & Western

THE DELAWARE, Lackawanna & Western started the use of treated bridge ties in 1905. From that date until 1909 the majority of the bridge tie renewals were made with treated timber. In 1907, 7 in. by 9 in. sawed heart yellow pine track ties were placed in the new train shed at Hoboken. These ties are still in service after 20 years and give every indication that they will last 20 years longer. We did not have as good success with our bridge ties. The 8 in. by 8 in., 8 in. by 10 in., and 8 in. by 16 in. bridge ties, especially on the main line, were destroyed mechanically long before they showed any signs of decay. They were not large enough and the deep flange tie plates did much to hasten their destruction.

In 1909 we decided to arrange for the treatment of all ties and bridge timber, and since that year all of our ties have been treated with creosote oil, excepting such chestnut ties as were available for use on minor branch lines and sidings.

Large Tie Plates Essential

The experience we had with the mechanical failure of our 8-in. pine bridge ties led us to make an exhaustive study to determine the proper means of protecting our treated cross ties against mechanical wear. After an extended study, in which we were ably assisted by Dr. Herman von Schrenk, we reached the conclusion that we should adopt a flat bottom tie plate for use on all main track ties. The screw spike was in turn adopted in place of the cut spike to give us the maximum holding power and at the same time extend the life of the creosoted tie as long as possible against mechanical wear.†

It will be readily understood that such tie plates above cannot well be used with undersized ties. Since we started to treat all of our cross ties in 1910 we have insisted on reasonably uniform ties for all of our main track work and since 1911 we have been boring and adzing all ties before treatment.

In 1910 it was generally considered unwise to treat white oak ties, since they take little treatment and give satisfactory service during a reasonable life without treatment. On the other hand beech ties were considered good for treatment. It seemed reasonable that a light treatment that would so materially extend the life of a beech tie ought to be valuable in extending the life of a white oak tie and we questioned why we should not go to the added expense of treating the white oak tie and thereby extend the life of the best tie we have ever known. Experience has proved that this was a wise decision.

We purchased local hardwoods and for the first few years a large number of sap pine ties. The Lackawanna has a large mileage of curved track with heavy grades. We soon found that the sap pine ties cut too rapidly on the curves in spite of the heavy plates and screw spikes used to protect them, so about 1914 we discontinued their purchase and since then have used hardwoods exclusively. The

Heavy Tie Plates and Screw Spikes on the D. L. & W.

sap pine ties have, however, given wonderful service on branch lines and on our main line tangent tracks. As a rule we have secured from 8 to 12 years of service from sap pine ties on curved track, while a majority of these ties placed in tangents during 1910, 1911 and 1912 are still in service with a prospect of much longer life. It is quite likely that we will use many treated pine ties in the future, but as far as possible they will be confined to branch lines or tangent tracks on the main line.

Records of Renewals

Fortunately, we have a very good record of all ties used per annum per mile of all tracks, and for the 16 years from 1900 to 1915, inclusive, this averaged 238 per annum. This indicates an average life of 11.6 years. The average number of cross ties used per annum per mile of all tracks for the 10 years from 1918 to 1927, inclusive, was 120.4, giving an average tie life of 23 years.

During the last five years, from 1923 to 1927, in-

*From a paper presented before the convention of the American Wood Preservers' Association at Montreal, Que., on January 25.

†This was followed by an account of the development of the D. L. & W. tie plate. See October, 1927, issue, page 432.

clusive, the average number of ties renewed per annum per mile of all tracks was 94.5, which figures an average tie life of 34 years. This remarkably low figure is due partly to the fact that the first treated ties placed have not been in the track a sufficient length of time to reach their normal cycle. From the present indications it is my belief that the number of ties we will have to use in maintenance per mile per annum for the next two or three years will not exceed 100 and it is quite probable that the number will then increase until a uniform rate of somewhere between 110 and 135 is reached. A renewal of 111 ties is equivalent to a 35-year life and 138.5 per annum to a 20-year life.

Now, let us see whether or not our records to date indicate that we may expect an average life of 20 years or more. Up to January 1, 1927, we had removed from all tracks a total of 174,897 treated ties. Of these, 118,805 were removed because of mechanical wear, 52,167 were destroyed in wrecks, derailments, etc., and only 3,925 were removed on account of decay. Of the latter, 110 were oak, 328 beech and birch, 1,120 pine and 2,367 maple and gum.

During 1910 and 1911 we placed more than 800,000 treated ties. The total number of decayed creosoted ties removed from all tracks in 18 years has not amounted to one-half of one per cent of the treated ties placed in the first two years. Of the 170,972 ties removed from tracks on account of excessive wear, wrecks and derailments, 99,365 were re-used in minor tracks.

The Savings Effected

In determining the actual saving in ties used, I call your attention to the fact that the average number of ties used per annum in maintenance on the Lackawanna from 1900 to 1915, inclusive, was 579,090 and from 1918 to 1927, inclusive, 322,674. The total number of ties in all tracks for the 10 years from 1918 to 1927, inclusive, was 10.6 per cent greater than for the 16 years from 1900 to 1915, inclusive. Therefore, to make a fair comparison between the years 1900 to 1915, inclusive, with the years 1918 to 1927, inclusive, we must add 10.6 per cent to the average number of ties placed in the former years, bringing the total for that period up to 640,473.

For the last five years, from 1923 to 1927, inclusive, the average number of ties placed per annum was 255,161, while the total number of ties in track during the five years in question was 11.8 per cent greater than between 1900 and 1915. Therefore, to make a comparison of the ties used in maintenance during the last 5 years with the 16 years from 1900 to 1915, inclusive, we must add 11.8 per cent to the average ties in the track for the former years, and we thus find a total of 683,326 as compared with the average of 255,161, thus showing a saving of 428,165 ties per annum during the last five years.

Likewise our records show that we used an average of 619 sets of switch ties per year from 1910 to 1917, inclusive, while for the nine years from 1918 to 1926, inclusive, we used an average of only 353 sets. Prior to 1910 most of our switch ties were long leaf yellow pine, purchased in the South, whereas since we started to treat local hardwoods we have been able to secure all of our switch timber local to our line.

The general data which I have given above should be sufficient to convince anyone that the Lackawanna has gained much by the treatment of ties. It is impossible to compile accurate figures as to the money saved. Nevertheless, by making certain assumptions one can arrive at an estimate of the final cost, including interest, of a creosoted tie placed in 1910 in comparison with the cost of untreated ties from the data shown and spanning the same period.

Hypothesis:

Life of an untreated tie—10 years.	
Life of a treated tie—20 years.	
Cost of untreated tie f. o. b. line 1910	$0.60
Cost of untreated tie f. o. b. line 1920	1.37
Cost of treated tie f. o. b. line 1910	1.00
Handling and placing costs 1910	.25
Handling and placing costs 1920	.50
Excess cost of screw spikes over cut spikes and two heavier tie plates used for treated tie in 1910	.40
Interest, 5 per cent per annum, compounded.	

Development:

Cost of first untreated tie in track in 1910	$0.85	
Compound interest at 5 per cent on $0.85 for 20 years	1.41	
Cost of second untreated tie placed in track	1.87	
Compound interest at 5 per cent on $1.87 for 10 years	1.18	
Total cost of untreated tie at end of 20 years		$5.31
Cost of teated tie in track 1910	1.25	
Compound interest at 5 per cent on $1.25 for 20 years	2.07	
Excess cost of screw spikes and tie plates	.40	
Compound interest at 5 per cent on $0.40 for 20 years	.66	
Total cost of treated tie at end of 20 years		$4.38
Saving at end of 20 years by use of treated tie on above hypothesis		$0.93

These figures indicate that by 1930 the Lackawanna will have saved 93 cents on every treated main track tie placed in 1910. During the first six years we used an average of over 500,000 treated ties per annum, from which it will be seen that the actual saving has already amounted to a considerable figure.

In considering the matter of financial gain the question is always raised as to the extent to which it is advisable to spend money for improved fastenings in order to lengthen the life of treated ties. I have included the excess cost of heavier tie plates and the added cost of screw spikes as compared with cut spikes in the development cost for the treated ties. The actual amount of the excess, based on 1910 prices, is slightly less than 40 cents. The compound interest on 40 cents for 20 years amounts to 66 cents, so that I have added $1.06 to the development cost of the treated tie over the 20-year period. I have also estimated the cost of handling and placing under normal maintenance conditions as 25 cents in 1910 and 50 cents in 1920. If the estimate for 1910 is reasonable, certainly 50 cents is conservative for 1920.

[A similar analysis, based on present-day prices indicates that the Lackawanna is saving $1.26 per tie by reason of the standards of construction and policy of treatment.—Editor.]

Summary of Advantages

From this it will be seen that there is still a very wide margin in favor of treated ties. This margin is certainly more than sufficient to pay the added expense of such improved fastenings as are necessary to secure an average life of 20 years for the treated ties.

Some of the gains that we feel have been accomplished by the treatment of ties, aside from the reduction in the number of ties used, are as follows:

1. The treatment of ties has made it possible to utilize such woods as mixed oaks, beech, birch and maple, whereas such woods are practically useless for untreated ties. Such timber is still available in considerable quantity along our line; incidentally, the treatment of the ties has given the farmer an additional outlet for this class of timber.

2. The total number of ties required has been so reduced that we are now able to secure most of our ties along our line; in fact, recently, for a period of three years, we did not purchase any ties off our line. This is of great advantage in more ways than one. First, it is important that ties cut for treating purposes are properly cared for in the woods along the right-of-way before shipment to the treating plant and when ties are purchased local to the line it is an easy matter for the railroad company's inspectors to instruct the sellers how to handle them. By keeping in close touch with the local tie producers our inspectors have been able to secure the necessary oak for switch and bridge ties, so that we do not now have to ship in yellow pine for either of these uses.

3. The reduced number of ties required for maintenance is a big help, especially in times of labor shortage. The placing of cross ties is not the big job that it used to be and the men have more time for other work.

4. From the very start we have considered it essential to secure good ties, uniform in size. This is necessary in order to get uniform seasoning and uniform treatment. We feel that our campaign in this respect has been the means of providing a more uniform and better track.

5. Through the use of screw spikes and heavy tie plates, adopted for the purpose of prolonging the life of the ties, we have incidentally maintained a stronger and better track.

6. The 130-lb. rail that we are now laying in main tracks is laid on a canted tie plate. To secure uniform bearing for these plates our principal assistant engineer, Mr. Neafie, has developed a tie scoring machine, by means of which all ties in the track are scored or sawed to a uniform depth on either side of the tie plates supporting the rail. Uniform ties that are full size are not marked, but those in which the old tie plates have seated are scored. The adzing of the ties can then be done uniformly with a certainty that all plates have a uniform bearing when laying new steel. This device saves work and makes it possible to do a better job of laying new rail. Its development was brought about entirely through our effort to save injury to creosoted ties already in service.

The Explanation of Low Renewals

I have often been questioned about our low annual tie requirements during the past few years. Many do not seem to understand how it has been possible to bring about a condition where for a number of years in succession less than 100 ties per mile of all tracks are required in maintenance. It is a fact that many roads using creosoted ties extensively do not have as good a record. It is my belief that the reason for our showing is threefold, as follows:

1. From the start we went into creosoting in an extensive way. We endeavored to treat all ties for both construction and maintenance work, including white oaks, and excepting only such chestnut ties as were available, these being used in minor branches and sidings.

2. The care that was used in the purchase of good, uniform ties and the heavy treatment used, 3½ gal. in all main track ties.

3. The use of big, flat bottom plates with screw spikes and the boring and adzing of all ties before treatment.

I know of no fairer way to compare maintenance costs than by the percentage of the total operating revenue consumed by maintenance of way and structures expenses. I submit the following comparison of the maintenance ratio for a few typical roads, selected at random. The first column indicates the traffic density, that is, the gross ton miles per mile of road per day for 1925. You will note that the Lackawanna shows by far the lowest maintenance ratio of any of the roads in the table. There are few, if any, other roads in the United States that have shown a maintenance ratio under 10 for five consecutive years. Whatever these figures may show, they at least do not indicate that the extensive treatment of ties and the use of screw spikes and other expensive track appliances to save mechanical wear of the ties has increased our maintenance expenses.

Comparison of Maintenance Ratios

Per Cent of Total Operating Revenue Consumed by Maintenance of Way and Structures Expenses for Calendar Years, 1921 to 1926, Inclusive, and Ten Months of Calendar Year 1927

Traffic Density (Gross Ton Miles per Mile of Road Per Day, 1925)	Carrier	1921	1922	1923	1924	1925	1926	10 Mo. 1927
31,562	D. L. & W.	11.66	10.56	8.68	8.94	9.97	9.67	9.95
36,045	C. & O.	14.65	12.62	12.61	14.39	15.24	14.22	14.33
33,205	N. & W.	14.59	13.80	13.00	15.14	14.36	13.63	13.80
32,824	P. & R.	11.51	10.59	10.19	12.26	13.17	13.84	13.93
28,826	Erie	12.45	11.88	10.76	11.64	11.40	11.41	12.46
25,948	Penna.	12.21	12.15	11.83	11.47	12.65	13.01	12.91
25,130	L. V.	10.35	11.33	10.29	11.02	11.52	11.40	11.48
23,252	N. Y. C.	10.16	11.41	12.01	12.55	13.67	13.49	14.10
22,413	B. & O.	12.41	11.61	11.49	11.87	11.97	12.49	12.12
21,038	C. R. R. of N. J.	12.34	11.18	9.86	10.92	11.43	11.25	9.34
11,433	N. Y. N. H. & H.	14.90	13.38	12.21	12.50	12.84	13.17	13.86
21,844	N. Y. C. & St. L.	11.25	11.73	12.41	13.44	13.35	12.85	13.05
20,552	C. C. C. & St. L.	11.70	.....	11.59	12.31	11.97	11.72	12.02
17,573	U. P.	11.32	11.11	12.34	12.43	11.61	11.51	11.95
17,021	I. C.	13.95	13.25	14.75	13.76	14.79	14.24	11.70
9,764	A. T. & S. F.	9.56	15.66	13.64	15.38	13.81	13.06	16.90
9,207	C. B. & Q.	13.70	12.60	12.84	11.93	12.40	14.85	14.32
7,824	C. & N. W.	14.71	13.22	14.53	15.09	14.13	15.09	14.08
6,696	S. P.	14.39	12.98	13.28	13.53	13.28	13.71	13.18
15,214	L. & N.	15.90	13.92	13.40	14.61	14.29	14.76	15.16
9,454	Sou.	14.96	13.45	13.77	13.53	13.69	13.54	14.11
6,830	S. A. L.	11.69	11.73	13.35	14.70	13.47	13.41	12.26
7,920	A. C. L.	14.81	11.91	12.60	13.03	11.51	13.41	15.93

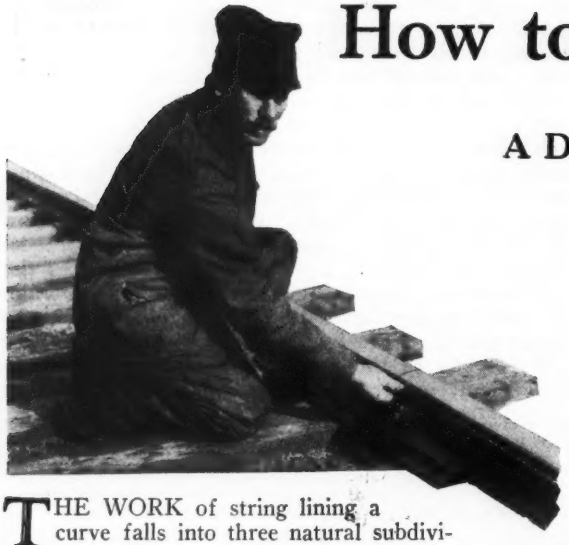
The Status of Screw Spikes

In concluding I desire to take this occasion to correct an impression that seems to have arisen that our screw spike experiment proved a failure. We have not discontinued the use of screw spikes. Our present standard tie plates weight 20 lb. each. These tie plates are fastened to the ties by screw spikes independent of the rail fastening, while our rail is held to gage through the tie plates and the base plate of our joint by means of raised shoulders on either side of the rail, ½ in. in height and $\frac{7}{16}$ in. in width at the top. Cut spikes are driven through these shoulders in pre-bored holes for the sole purpose of keeping the rail from raising out of the groove. These spikes also assist in holding the plates to gage, but the screw spikes are the fastenings upon which we depend to hold the gage and to prevent movement between the tie and the plate. I do not consider that our screw spike test, now 18 years old, has been a failure in any sense of the word.

How to Measure a Curve

A Description of the Steps to Be Taken in Securing Data Regarding an Existing Curve

By CHARLES H. BARTLETT



THE WORK of string lining a curve falls into three natural subdivisions. These are, in the order of their occurrence:

1. The taking of the necessary field data of the existing curve, and their arrangement and recording in such manner that the necessary computations will be shortened and facilitated as much as possible, in order that mistakes will be rendered improbable.
2. The computation of the throws required to correct the various defects of alinement of the existing curve.
3. From the corrections computed, the setting of stakes or other guides by means of which the section foreman and his gang will be enabled to re-aline the curve.

Of course, a fourth subdivision might be added—namely, the checking of the revised curve after the work of re-alining has nominally been completed. However, this is practically never done and, as a matter of fact, is needless if the work has been carefully done throughout.

This article deals with the methods of taking the required information—that is, the characteristics—of the existing curve. Before discussing these methods it seems advisable to recall certain properties of the circular curve.

Basis of String Lining

Railway curves can be divided into two broad classes: (1) circular curves and (2) spiral or easement curves. In the original location of a line, before the track is laid, the circular curve only is staked out; the spiral is left until the greater portion of the curve is actually laid and is then staked out by the engineer or is left to the track foreman to put in by eye. For this reason, and also because the spiral requires special treatment, the circular curve will be considered first.

Both theory and experience prove that, in order to provide and maintain good riding qualities in a curve, it is necessary to keep truly circular that portion which was originally constructed as a circle. This can be done in several ways. With a transit, advantage is taken of the principle that, for equal chord lengths along a circle, the deflections from a tangent at the point of curve are (angularly) equal. String lining takes advantage of the principle that, for equal chord lengths along a circle, the ordinates from the center point of the chord, measured perpendicularly thereto, are equal. And, just as for a given degree of curve there is a characteristic deflection for each chord length, so for that same degree of curve and same chord length there is a single characteristic middle ordinate. Therefore, if the middle ordinates of a given curve, measured from equal chord lengths, are all equal, that curve is a true circle.

It is well known that a curve which is a true circle when originally laid will eventually, as a result of outside forces such as engine and car wheels, temperature changes, etc., become a series of curves, some or all of which may be of different degrees of curvature. This naturally makes for rough riding track. It is the purpose of string lining to restore the circular character of the curve by making the unequal middle ordinates of the actual curve all equal. In order to do this with the minimum of expense, time and interruption of traffic, it is first necessary to obtain a record of the middle ordinates, for a given chord length, on the entire curve.

Selecting the Chord Lengths

The best length of chord depends on certain factors, chief of which is the length of rails in the track. If the entire curve is composed of rails of equal length, such as 30 or 33 ft., the best chord length is equal to twice the length of rail; that is, 60 or 66 ft. Since all ordinates are measured from the chord to the high rail of the curve (because measurements can then be taken to the gage line of the rail) only the length of rails in the outer rail need be considered. If, however, the rails vary in length (as sometimes happens) the writer recommends a chord length of 66 ft., because all the tables used by him are based on the use of that length of chord and, therefore, such data as may be required can be obtained directly from tables, without computation.

The reason for selecting a chord equal in length to two rails is that this permits of setting a stake at every joint, if desired. The advantages of a center stake every rail length, at the joint, over a center stake every 50 or 100 ft., are readily realized, and are fully appreciated by the track foremen who have to do the work of lining. A much more uniform curve is secured with the expenditure of no more time or labor. Only the very best of foremen are able to line 100 ft. of curve of any degree without having

*This is the second of a series of articles on the string lining of curves, describing the manner in which the line can be corrected by trackmen without the use of instruments other than a piece of string and an ordinary rule. The first article of this series, which appeared in the January issue, page 4, presented the merits of this practice in contrast with the use of a transit. The third article will appear in the April issue.

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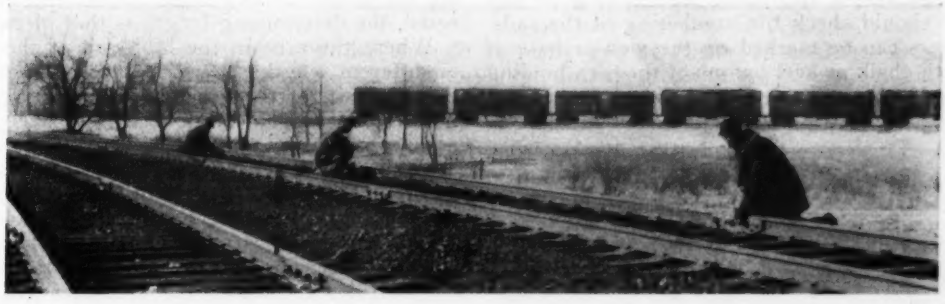
for String Lining*†



slight sharp and flat spots. These irregularities, although almost unnoticeable at first, lead very quickly to generally poor alinement.

The accompanying table gives the middle ordinate in tenths of an inch, for a one-degree curve for a number of chord lengths.

Measuring the Curve

Theoretically, on perfectly straight track, the middle ordinate (for any length of chord) is zero. If the actual tangent track was perfectly straight, the first ordinate with which we should have to deal would be a zero, at the end of the curve. However, for reasons explained later, it is frequently advisable to start well back on the straight track—say five or six rail lengths—to measure the middle ordinates. Although string lining does not undertake to change tangent alinements, it does permit of making detailed corrections thereto at the ends of curves, if there are small variations in the straight track.

For example, it will nearly always be found that the last ordinates—the first and last on the curve, and the next adjoining ones just off the curve—are not zero. A typical case, taken from an actual curve, measured with a 66-ft. chord is as follows:

	Middle Ordinate
Joint Number 1	0.2 in.
" " 2	0.2 "
" " 3	0.0 "
" " 4	0.1 "
" " 5	0.2 "
" " 6	0.0 "
" " 7	0.4 "
" " 8	1.2 "

The joints below the horizontal line are on the curve, while those above are on what is supposed to be perfectly straight track. It is possible in string lining to make all of the ordinates above the line equal to zero, thereby making a perfect tangent track and contributing materially to both the appearance and the riding qualities of the curve at the ends.

With the above in mind, let us assume we have an actual curve to measure. The steps are as follows:

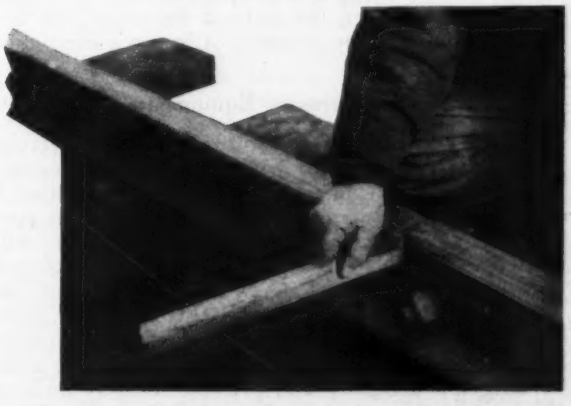
First, locate by eye the end of the curve; then go to that point, have one man hold one end of the string against the gage line of the high rail at the joint next farther from the curve than the joint to be measured. Another man holds the other end at the gage line of the high rail two joints nearer the curve. The third man then measures with a rule the middle ordinate at the intervening joint. If the ordinate is zero, and the track back of him (on the tangent) appears to be in fairly straight line, he can call this Joint No. 1. All three men then move up *one* joint nearer the curve, so that the ordinate at every joint is measured. (See Fig. 1.) Care should be exercised that no joints are omitted. A natural error for a beginner would be to move up a whole chord length, instead of half a chord length, as outlined above.

In order to identify the different joints, it is well to number them consecutively. It has proved very satisfactory to number the first joint and every fifth one thereafter until the end of the curve is reached. The last joint is given its proper number, whether that number is a multiple of five or not.

It is obvious from the foregoing description that three men will be needed to measure a curve. Only one of these men need be conversant with the principles of string lining, since the only duty of the other two is to hold the ends of the string tightly against the gage line of the high rail and to see that the string is properly taut at the time an ordinate is measured. Laborers from the section gang are gen-

Middle Ordinates of Different Chords for a One-degree Curve

Length of chord in feet	10	20	30	31	33	39	50	54	60	62	66	78	100
Middle ordinates in tenths of an inch	0.26	1.05	2.36	2.52	2.85	3.98	6.54	7.63	9.42	10.06	11.40	15.93	26.18



The Ruler Can Be of Any Desired Size and Shape

erally selected for this duty because of their being close at hand and readily available for the short time required to measure the curve.

The man who measures the middle ordinate should select the points of beginning and ending of the curve, and should check the numbering of the rails. The numbers can be marked on the web or base of the rail with chalk or keel by one of the men holding the end of the string, preferably the man at the rear.

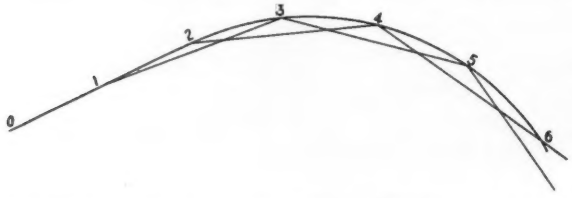


Fig. 1—Method of Measuring the Middle Ordinates of a Curve

The numbers indicate the string lining stations along the curve.
Joints or stations 0, 1 and 2 are on straight track.
The ordinate at station 1 is measured with one end of the string at station 0 and the other end at station 2.
The ordinate at station 2 is measured with one end of the string at station 1 and the other end at station 3.
The same procedure is used to take all the ordinates of the curve.

The recorder can then call off the numbers in some such fashion as: "Going to No. 45" or "You're at No. 45 now."

The recorder should provide himself with a sheet of paper upon which are ruled horizontal rows of lines. These he should number consecutively to correspond with the joint numbers. It is, of course, desirable for him to estimate beforehand the approximate number of rails in the curve, as this is a time-saver. Opposite each joint number is placed the middle ordinate, for the given chord, at that joint. This should be put down as soon as measured, to avoid the possibility of errors due to an effort to remember some of the ordinates.

Correctness of the original ordinates is a prime essential to the success of the string lining method, and care should be used to see that the measurements are uniformly accurate. Experience will show just what tension of string is required to secure an accurate measurement in the shortest possible time. If the string is not taut enough in the opinion of the recorder, he should call to one man to pull up on it slightly. If the ordinate changes, it is then apparent that the proper tension of the string had not been secured. Too great a tension will, naturally, break the string, but little fear is to be anticipated from this source after the proper pull is once ascertained. If the string does break, however, it should not be tied between the ends of the chord, as this obviously impairs the accuracy of the measured middle ordinates.

The Necessary Equipment

In order to obtain an unbroken length of string 60 ft. or more in length, it will usually be necessary to purchase 100 ft. of cord. The author's experience has been that all the ordinary varieties of cords purchasable at hardware stores or stationery stores will stretch appreciably at first. This need not be a source of worry, however, as long as the string is taut. A good plan to follow is to buy 100 ft. of string, such as that used by masons and bricklayers, tie both ends securely to wooden handles—which enable the ends to be gripped tightly and pressed securely against the gage of the rail—and then wind the unused portion on one stick. After a short period of use, the string will no longer stretch, and a fairly accurate chord will be determined by the length of the string itself, although this is not the guiding factor in fixing the proper chord length. Where all the rails are equal, the determining length is that of two rails.

Where the rails in the high rail of the curve are of different lengths, it will be necessary to chain or measure out the curve before taking any of the ordinates. This should be done with a steel tape or, if none is handy, with a metallic tape. Stations of 33 ft. are marked along the high rail, and numbered as before. The string should not be used for measuring the length of the curve because of the accumulative errors caused by stretching of the string and inequality of tension between different stations.

The ruler by which the ordinates are measured can be of any convenient size or shape. A triangular scale, of the type used by engineers or architects, makes an excellent rule, if the excess at one end is cut off so that the zero of the rule is at the end of the scale, although any rule whose graduations start at the end can be used. Whether an engineer's or an architect's rule is used depends upon the unit of measurement adopted. This leads naturally to the question of what is the best unit for the purpose.

Unit of Measurement of Middle Ordinate

Middle ordinates can be measured in any unit which appeals to the man who makes the calculations and takes the measurements of a curve. However, the selection lies almost entirely between the three

First Curve S. of M.P. 119 S.B. Main — C.N.B. 1-20-28 and 2 men

Joint No. (or Station)	Ordinate (Distance from String to Station of Rail Head)	Remarks
1	1	15'-7½" ℄ trk to ℄ N.B. Main
2	2	
3	4	
4	11	
5	11	
6	9	Sta 6+10' - Battery 4ft 1'-4" out
7	11	
8	13	
9	10	
10	11	Signal 6-41.2 8'-9" out (Edge of Fills)
1	18	15'-5½" ℄ trk to ℄ N.B. Main
2	12	
3	7	
4	14	Open ditch for Trestle over Black Creek
15	10	# M.43
6	10	
7	4	
8	15	
9	18	15'-6¾" ℄ trk to ℄ N.B. Main
20	12	
1	6	P.L. Turnout on X over
2	8	
3	15	Sta 22+15-9 P.L. #10 L.H. Spring Frog
4	9	
25	7	
6	5	
7	3	
28	0	
		50 M.P.H. Track

Fig. 2—A Specimen Page of Notes

following units: (1) the tenth of an inch, (2) the eighth of an inch and (3) the hundredth of a foot.

Engineers are accustomed to measuring small quantities in hundredths of a foot, and this unit is suitable for practical purposes from their standpoint. However, the track foreman is not accustomed to this unit and, since he is vitally interested in the amount of throw required to correct the alinement

of a curve it appears best to use either the tenth or the eighth of an inch. Further, the hundredth of a foot is not quite as accurate (by about 20 per cent, regardless of the relative numerical values of the two units) as either of the other two.

The eighth of an inch is a practical unit from the standpoint of the track man, and suitable enough for the engineer. The chief objection—and it is an important one—against its use is that middle ordinates must be written first as inches and eighths of an inch (as 4⅞ in.) and then reduced to eighths only (as 4⅞ in. becomes 39/8 in., or more simply, 39). The work of reduction assumes important dimensions as the curves become longer.

The tenth of an inch has the advantages of both the above units, and the disadvantages of neither. It is equally suited to the needs of the engineer and trackman, it is sufficiently accurate to permit of obtaining correct measurements and securing excellent results. It has, too, the big advantage that ordinates written in this unit can be written directly as whole numbers. For example, an ordinate of 5.4 in. can be written down immediately, without further reduction, as 54. The advantage of this feature can be appreciated only after the reader has actually lined one or two curves.

Practical Hints

1. When taking the data on the actual curve, the recorder should make pencil notes of the station numbers of fixed structures, located on or near the curve, which are apt to govern or restrict the permismisible throwing of the track. For example, a trestle or steel bridge, the edge of a building, a deep cut, a high fill and other such obstacles form more or less serious impediments to the free throwing of a curve. Their position and extent should be noted by string lining station and plus.

The station and plus and the number of turnouts must also be noted for it occasionally happens that when a curve is re-alined, it it advisable or even necessary to change the number of one or more frogs and the corresponding turnouts.

2. The kind and quantity of ballast (per cent of standard ballast section) should be roughly noted down or remembered, in case it is necessary to throw portions of the curve a foot or more from their position before being re-alined. Although the road supervisor or road master is generally supposed to care for such matters as ballast requirements, after he has seen the stakes or otherwise learned the amount of throw at the various points of the curve, it is well to be able to give an approximate estimate of the quantity of new ballast, if any, which will be required.

3. Mental note should be taken of the grade line of the track through the entire curve, especially at the entering and leaving ends of the curve, for reasons explained in a subsequent article.

4. Ascertain from a timetable or other reliable source the speed of trains operated over the curve to be lined, as their speed affects the spirals or easements to be used.

5. If certain ordinates measure a half unit more or less than a whole number (as 5.75 in.=57.5 tenths of an inch) attempt to balance them by increasing some by a half and decreasing others by a half, as the sum of the ordinates is a measure of the total angular change of alinement, and should be constant.

6. The recorder should call "all right" as soon as he has finished measuring an ordinate, so that all three men may move up to the next joint or station without loss of time.

7. It will sometimes happen that the greater part of a curve will have rails of uniform length, but that near one end will be a turnout or road crossing where some short rails will be found. In such a case, it is usually not necessary to chain or measure with a tape the remainder of the curve, if the measurements be started at the opposite end and carried toward the point where the short rails are located. For example, suppose a curve to have 67 rails, 57 of which are all 33 ft. long, after which there are 3 short rails, the remainder being again 33 ft. rails. Measure the rails from the end where the lengths are uniform, and then continue the stationing through the short rails by means of the string. This, of course, presupposes that the man pulling the string has learned very approximately the right amount of tension to give him a chord of exactly 66 ft.

8. On double or multiple track roads, it is wise to take track centers at intervals around the curve, in order that the man making the computations may know definitely whether a certain maximum throw will be such as to affect the clearance distance or minimum track centers.

9. On double or multiple track roads, it is always better to line separately the same curve on the different tracks than to line one track and attempt to line the others by maintaining a uniform center distance. There are several reasons for this. First, the existing track centers may not be uniform, as is usually the case, and a relatively small throw on the one track may entail a much larger (even a prohibitively large) throw on the next adjacent track. Second, most track foremen do not have steel tapes, but have cloth tapes which stretch as much as 3 or 4 in. in 25 ft.; consequently, the foreman cannot maintain really uniform track centers by means of such a tape. Third, it is nearly impossible to measure the center-to-center distance of curved tracks along the true radial line; and a small error in angular direction of measurement means an appreciable error in true radial distance. Fourth, the entering and leaving spirals are of different lengths and different spiral characteristics, which makes it impracticable to maintain uniform centers on spirals, even though the degrees of the circular curves are the same. For these reasons, where it is desired to line two or more tracks on the same curve, it is best to take the data separately for each curve as an entity.

10. Before going out to measure a given curve, the recorder or his superior should ascertain if any work is contemplated on the curve, and, if there is to be some work done, he should defer the measuring until such time as the track will remain undisturbed between the time of measuring it and the time of setting the stakes. It sometimes happens that data will be taken for a curve, and then a portion or all of that curve will be moved, relaid, or otherwise disturbed materially, rendering the data taken worthless—even a liability, in case stakes are set from throws computed from these data.

11. While the author strongly recommends using the tenth part of an inch as the unit for measuring the distance from the string to the gage line of the high rail, because of the fact mentioned above that such readings can be written as whole numbers without any further change (as, for example, 6.2 inches is 62), nevertheless, he is fully aware that most track men do not have a ruler graduated in

tenths of an inch and cannot easily secure one. Consequently, for their purpose it will be best to use an eighth of an inch as the unit, and then reduce the ordinates measured to whole numbers in order to work with them more easily. It is obvious that it requires some little thought to subtract 3⅞ inches from 4¼ inches and get ⅜ inch; and it is equally obvious that it is much easier to reduce 3⅞ inches to 31/8 and 4¼ inches to 34/8 and then subtract 31 from 34, leaving ⅜. The best way to do this is to make a little table, which can be referred to at any time, and which gives the "whole denominators" for the inches and eighths of an inch. The foreman should start out and make his own table, thus:

⅛ in.	1	1 in.	8
¼ in.	2	1⅛ in.	9
⅜ in.	3	1¼ in.	10
½ in.	4	1⅜ in.	11
⅝ in.	5	1½ in.	12
¾ in.	6	etc.	etc.
⅞ in.	7		

Such a table will pay for the labor required to make it many times over. In fact, it is almost a necessity if the ordinates are measured in eighths of an inch.

12. Throughout this entire series of articles, wherever the word gage is used to indicate a point on the head or ball of the rail, it should be taken to mean the lowest point on the head of the rail on the gage side, rather than the theoretical gage line of the rail, which is about ⅜ of an inch from the top of the rail. The reason for this is that almost all curved rails wear unevenly and the only point which is definitely determined is the lowest point of the head, where the wheels do not touch or at least touch but a little.

13. The foreman must not get the idea that this system will work only for 33-foot rails. Any chord length at all will do, just so the same chord is used to measure the entire curve. If a curve happens to be laid with sawed rail only 27 ft. long, then the proper chord to use is twice 27 or 54 ft. As far as the foreman or trackman is concerned, one chord length is just as good as another; but for the purposes of any engineers using the method, the best length is 33 ft., because all the tables giving the enginer information have been worked out for that length rail (that is, for a 66-ft. chord), and considerable time and computation will be saved when figuring central angles, spiral functions, etc. For relining purposes only, however, no tables are needed and any length will do.

Reballasted Track of the Denver & Rio Grande Western

Creosoted Ties Are Loaded Cheaply by Gasoline Crane

BY USING a gasoline crane mounted on crawler treads for loading freshly treated ties at its creosoting plant at Escanaba, Mich., the Chicago & North Western has not only effected a marked reduction in handling costs and the time required for the work, but has also secured heavier loading, thereby reducing by approximately 30 per cent the number of cars required for shipping the ties. The Escanaba plant has a capacity of 6,000 ties daily and this method permits a day's output to be loaded in 11 cars, whereas 16 cars were required formerly.

Gasoline Crawler Crane Loading Creosoted Ties

In preparing the gondolas for loading, ties are placed upright around the sides and ends of the cars, thus forming a loading space to a height of eight feet above the floor, these ties being allowed to cool overnight on the tram cars. After the upright ties have been placed the crane picks up the load of 35 ties from each tram car as it comes fresh from the retort and hoists it into the gondola, using slings for this purpose, thus expediting the work by saving the time occupied in cooling the ties so that they could be loaded by hand. Aside from the men who place the upright ties, the loading gang consists of seven men: the crane operator, two men on the ground to apply the slings and operate a tag line and four men in the car to unhook the slings and straighten the ties.

The crane used in this work was manufactured by the Northwest Engineering Company, Chicago. It is equipped with a 45-ft. boom, with a capacity of 22,000 lb. at a 15-ft. radius and of 5,340 lb. at a 45-ft. radius. Power is furnished by a four-cylinder gasoline engine developing 70 hp. at 500 r.p.m. and the hoisting speed is 150 ft. per min. The boom hoist is so arranged that the boom can be raised or lowered quickly, while the length of boom and the load capacity permits the crane to reach over the gondola to pick up ties from the tram cars when conditions make this desirable.

Building Snow Fences of Trees

Canadian Pacific Has Found Them Effective as Well as Attractive

Approximately 110 Miles of This Protection Has Been Planted

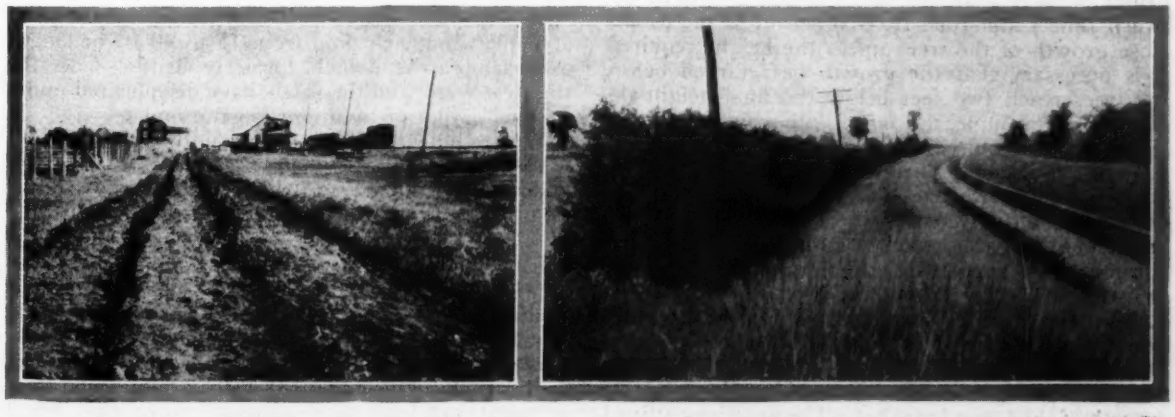
SINCE 1916 the Canadian Pacific has had under way a scheme of tree planting on its Eastern Lines which is serving a rather unique purpose. During the winter snowstorms, accompanied by the drifting of the snow, cause considerable worry to the operating officers as well as heavy expense to the railway in keeping its lines open for traffic. Cuts along the line fill up rapidly with the drifting snow and they are kept clear only by the intensive operation of heavy snow plows of various designs, propelled by large locomotives. To minimize the accumulation of snow in the cuts, it is the practice generally on the railways in Canada and in the northern part of the United States to erect stretches of heavy wooden board snow fences which are expensive to maintain and far from beautiful in appearance.

In an endeavor to eliminate this expense, the Canadian Pacific undertook a special study in 1916 of the possibility of using evergreen trees for snow fence. From that year until 1920 experimental planting was carried out in order to determine the right varieties of trees to use. Native spruce, balsam, cedar, white, red and jack pine, Douglas fir and hemlock were tried and it was found that cedar, spruce, jack pine and Scotch pine were the best evergreen trees adapted for the work. It was found that, generally speaking, a combination hedge using spruce for the front row and the quicker growing Scotch pine in the back row gave the best results. Since 1920 tree planting for snow fence has been carried on generally over the company's Eastern Lines and the railway has at the present time approximately 110 miles of evergreen hedge along its right of way. The cost of the work is only a fraction of the cost of the unsightly wooden board fence, and while it serves the useful purpose of keeping the railway cuts free of snow, it also forms a compact and attractive hedge which adds materially to the beauty of the landscape.

How the Trees Are Planted

Transplants 12 to 16 in. high are supplied for the work. Trees are planted in two rows four feet apart and staggered with the Scotch pine in the back row and the spruce in the front row. Planting commences in the spring as soon as the frost is entirely out of the ground and is continued for about four weeks. In the fall, planting starts about September 1 and can be continued until heavy frost comes.

A strip of ground, at a distance from the track de-



Young Trees Planted in the Plowed Strip **A Snow Fence After Seven Years' Growth**

pending on local conditions and from 10 to 12 ft. wide, is thoroughly plowed and harrowed for the total length of the snow break as early in the season as possible preceding the planting of the trees. This provides fire protection as well as preparing for planting. Trees of the same size are planted together. Young trees are delivered to the line packed in damp earth in cars or in boxes and care is taken to see that the roots are not exposed to the atmosphere until the trees are actually going into the ground, and even then to the least possible extent. Wet sacking is used to cover the trees when moving them from the car to the planting ground. If the fine roots are allowed to dry up the trees will die.

To replace the individual trees which, notwithstanding the utmost care, die after planting, an extra quantity of trees are delivered over and above the actual requirements. These additional trees are carefully planted two feet apart in any suitable cultivated location and later, when needed, are carefully transplanted along with earth surrounding the roots to replace trees that have died.

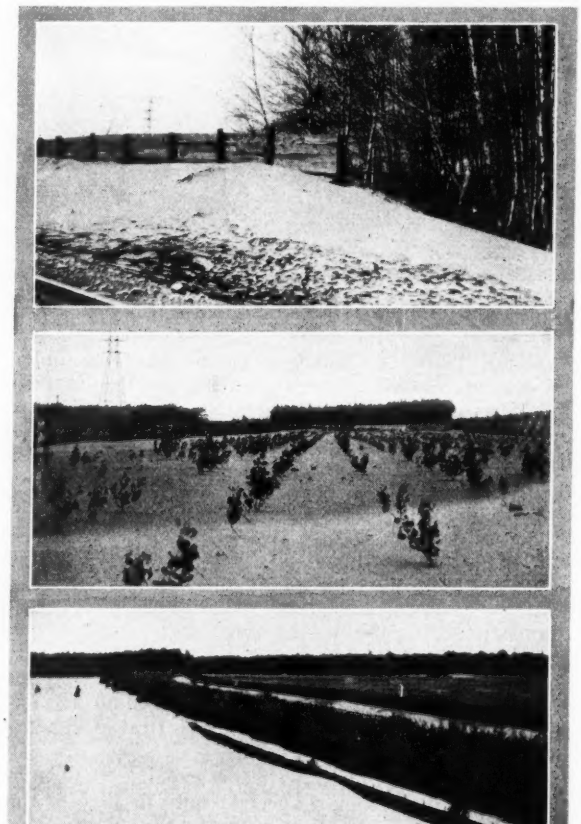
The first year after planting, the 12-ft. width above mentioned is kept cultivated to a depth of about three inches with a horse cultivator, where possible, and with a hand hoe close to and around the trees. Care is taken to see that grass, herbage, roots or rubbish is not allowed to collect around the base of the young trees, as this tends to kill the lower branches.

In the maintenance of trees planted for snow breaks, replacements are necessary from time to time due to improper planting, poor soil conditions, lack of cultivation, etc. Dead trees are removed as soon as this condition is apparent, so that they will not interfere with the growth of their neighbors and are replaced with new trees. Also, in certain locations, trees are liable to be attacked by disease, moths, etc., and they are carefully watched for attacks of this character. As soon as there is the slightest indication of such an attack the matter is reported and inspection and the application of the necessary remedy are arranged.

The Height Is Controlled

The height to which the trees are permitted to grow is determined by the local officers and depends on prevailing conditions with regard to the depth of the cut to be protected, the number of tracks involved, the width of the right of way, etc., but in no case are the trees permitted to have an ultimate height of more than ten feet. Pruning is done between June 1 and June 15. To permit of the proper close growth of the trees up to the height required, it is necessary that the growth be retarded before the trees reach two feet below the final height desired. For example, if a fence with a final height of eight feet is required, pruning is started when the growth has reached a height of six feet. When this point has been reached, the growth of that year on the main stem only, which is easily apparent on account of its lighter color, is pruned off. This has the effect of increasing the growth of the top branches which spread out and grow up to form new tops to the trees. When these branches reach the final height required for the hedge they are kept pruned off annually as noted above for the main stem. Pruning has the effect of accelerating the growth of the lower branches. The practice outlined, if properly followed, forces the development of the trees into a hedge, resulting eventually in a compact and solid snow break.

Another useful as well as ornamental use to which the company has put the planting of trees can be seen on some sections of its main line between Montreal and Quebec, where large areas of drifting sand were carried on to the tracks by the winds, interfering with the proper maintenance of the railway and causing discomfort to its passengers. Wooden fences were tried without success to stop the drifting sand, and in 1916 tree planting was resorted to. The company now has fine plantations of poplar and jack pine from 15 to 40 ft. in height over sand areas, which formerly drifted with the slightest wind, and the sands have disappeared under a green carpet of luxuriant vegetation.



In the Drifting Sand Area Between Montreal and Quebec
Sand drifted on the right of way prior to the planting of trees (top). Trees planted on a sand area (center).
General view of one of these drifts, showing effect of trees in holding sand back (bottom).

We are indebted for the above information to A. C. MacKenzie, engineer maintenance of way of the Canadian Pacific, Eastern Lines, under whose direction this snow protection has been installed.

EMPLOYEES OFFER SUGGESTIONS—The Bureau of New Ideas established recently by the Pennsylvania Railroad to encourage employees of the company to interest themselves in specific improvements in the service, has received already 650 individual suggestions, some of which, including No. 1, have been found to be of merit and have been adopted. Suggestion No. 1 had to do with efficient and economical use of stationery.

Condemns Contracting of Track Work by Force Account

Interstate Commerce Commission Objects to Practices Followed on Pittsburgh & Lake Erie

A SWEEPING condemnation of the contracts under which the Pittsburgh & Lake Erie has conducted a large part of its track maintenance during the last 10 years was made by the Interstate Commerce Commission in a report issued on January 3, following an extended investigation. The investigation and report covered the operations of several firms of contractors, but dealt primarily with those of Trelfall & McLaughlin and Corrado & Galiardo, and the portion of the report dealing with these firms is abstracted below. The operations of the firms were conducted on verbal agreements and none of them was required to give bond for the faithful performance of his work.

Terms of the Contracts

Under the terms of the verbal agreements with Trelfall and with Corrado the Pittsburgh & Lake Erie designated the number of men to be located at the contractors' various camps; designated the rates of pay of all men employed by contractors, the rate of pay varying according to conditions of the labor market; provided living, kitchen and dining quarters of men in the camps, as well as necessary equipment, fuel and light; provided transportation for men employed at points on its line, and reimbursed contractors for fares paid for men employed at off-line points to the nearest points on the railroad's line; reimbursed contractors semi-monthly, for actual pay rolls of all men furnished by latter, for sufficient labor pilots to pilot men to the various camps, and for necessary camp superintendents, cooks and camp help; paid the premiums for compensation insurance on men on the contractors pay rolls, and paid the contractors, semi-monthly, an amount equal to 10 per cent of the actual pay rolls. The contractors employed the men without office or fee costs to the railroad and were responsible for all camp equipment furnished by the railroad, ordinary wear and tear excepted.

A comparison of the hourly rates does not show the relative cost to the railroad of the different bases of employment. The hourly rate for employees on company roll represents the total cost, whereas to the hourly rate for employees on contractors' rolls must be added the allowances made the contractors for operating commissaries and camps, which include reimbursement for water, fuel and light; wages of camp superintendents, cooks, flunkies, crumb bosses and pilots; miscellaneous expenses; and in addition thereto, 10 per cent on the entire pay roll of the contractors. Because of this the cost to the railroad for track and roadway work performed by men on the contractors' rolls, per service hour, is considerably in excess of the rates paid the men.

The table shows the average cost per hour for productive labor on roadway and track, by annual periods or portions thereof from March 1, 1920, to June 30, 1925. The contractors' rate is computed by dividing the number of hours worked by roadway and track laborers on the contractors' rolls into the total amounts paid contractors, exclusive of the amounts paid to track and roadway foremen, and for compensation insurance.

Cost per Hour for Roadway and Track Labor Employed Direct and Under the Contract System
March 1, 1920, to June 30, 1925

Period	Average cost per hour in cents: Contractor's Forces	Railroad Forces
10 months, 1920	66.95	50.23
1921	34.87	44.51
1922	36.33	37.44
1923	49.62	39.30
1924	46.11	39.85
6 months, 1925	43.51	40.29
Mar. 1, 1920, to June 30, 1925	45.35	42.76

The payments to Trelfall and Corrado for the period from May 1, 1920, to June 30, 1925, totaled $6,083,068.05, of which $4,865,070.74 was paid for the foreman and laborers on productive work on the roadway. The remainder amounting to $1,217,997.31, represents what was paid to the contractors for superintendence of the commissaries and camps, wages of cooks, flunkies, and other commissary and camp labor, 10 per cent of total payroll, compensation insurance, and miscellaneous expenditures. Deducting the total amount paid for premiums on compensation insurance, $96,640.04, from the latter amount, on the theory that the carrier would have paid the compensation insurance premiums in any event, there remains $1,121,357.27, which is 23 per cent of the amount actually spent for track and roadway foremen and laborers on the contractors' rolls. This $1,121,357.27 contains the plus 10 per cent to contractors as well as an approximate 13 per cent for additional overhead, which includes camp superintendence, $89,596.84; wages of cooks, flunkies and other commissary and camp labor, $467,444.33, and miscellaneous expenditures amounting to $21,995.77.

Position of the Railroad

The railroad does not employ labor agents to solicit men for employment on its own rolls, but contends that if it attempted to maintain sufficient forces to perform all maintenance of way work, such action would be necessary. It has broadly disclaimed its ability to procure necessary track and roadway laborers without an extensive recruiting organization, and without greatly increased local and general office overhead expenses. It also contends that it cannot house and feed track laborers without the organization of a separate department.

Representatives of the Pittsburgh & Lake Erie, in making these assertions, overlook the facts that under the present contract system the railroad already provides living, kitchen and dining quarters together with necessary equipment; it also furnishes fuel,

water and light; camp supervision, cooks, flunkies and labor to keep camps clean; pilots to handle men to the various camps; and approximately thirty time checkers to see that contractor's time records are correct; and it provides for the allocation of the necessary time of its own officials and clerks to properly supervise and handle the business affairs with the contractors. These elements constitute a large portion of the items necessary to maintain and operate commissary camps. The only remaining elements which the road has not assumed are recruiting and feeding the men.

Railroad Offers Analysis

It was stated in behalf of the Pittsburgh & Lake Erie that it had "made a careful, detailed study in order to determine the possibility from an economic standpoint, and standpoint of efficiency, as to whether or not the railroad company could run those camps," and that "we arrived at the conclusion that it was more economical and more efficient to have it done by contractors than by the railroad company."

Exhibits and testimony were presented based upon estimates of what the added cost would be to itself if it operated commissaries and recruited its own labor. One of the exhibits is reproduced here.

Estimated Cost of Company Labor to the P. & L. E. if the Railroad Operated Camps and Obtained Own Labor

Based on 1200 laborers—30-man Camp—25 day month

30	Laborers at 9 hr. at 40 cents per hour	$108.00 per day
1	Cook at $125 per month	5.00 " "
1	Flunky at $100 per month	4.00 " "
1	Crumb boss at $100 per month	4.00 " "
11	Pilots (based on 1 pilot for four camps ¼ x 9 hr. x 40 cents per hour	.90 " "
1	Superintendent—¼ x 9 hr. x 70 cents per hour (1 Superintendent for 4 camps)	1.58 " "
1	Camp clerk	4.00 " "
2	Labor agents at $3,000 per year	.50 " "
1	Supervisor of labor at $360 per month	.36 " "
	Extra general office expense, clerical ($14,180 per year)	1.18 " "
	Truck transportation, including drivers	1.07 " "
	Telephone and stationery ($600 per year)	.05 " "
	Labor office rent (2 offices at $1500 per year each)	.25 " "
	Compensation on labor at 2 per cent	2.48 " "
		$133.37 " "

270 hr. effective labor.

Cost per hour of effective labor—$0.4940.

It is assumed that the cost of lost meals, ice, laundry, and other incidental expenses will be covered by the amount of board charged the laborers.

This exhibit shows that to the base rate of 40 cents per hour for track labor there is added an estimated 9.4 cents for recruiting and commissary service.

The analysis shows that 6.7 cents of this 9.4 cents is now being paid by the railroad and not by the contractors. This leaves 2.7 cents per hour as the added cost under this analysis, to be paid by the railroad.

Applying the increment of 2.7 cents to the total service hours of the contractors' track and roadway forces, 13,036,120 hours, the resulting increase in cost would amount to $351,075.24. This amount is $190,345.09 or approximately 35 per cent less than the $542,000 paid to contractors as the 10 per cent of payrolls. The railroad's exhibit was based upon 1,200 track and roadway men on contractors' rolls. The record shows that during the periods in the following years the average number of contractors' employees were respectively:

1920	303
1921	791
1922	702
1923	1206
1924	1171
1925	1125

It is shown that during certain periods the productive track labor man-hour cost more under the contracting plan than it cost per hour for men on company rolls. During other periods the cost was less. The railroad claims a net gain of $155,918 for the five years and four months period. This estimate is based on contractors' rates plus 10 per cent applied to the laborers working hours on track and roadway work. No consideration is given to the camp and commissary costs which must necessarily be included and amount to $89,596.84 for camp and commissary superintendence, $467,444.33 for cooks, flunkies, etc., and $55,704.11 for the 10 per cent on the payroll of these employees. Items of miscellaneous expense amounting to $21,995.77 were also ignored, all making a total of $634,741.05 which was not considered in the estimate.

Commission Estimates Loss of $611,268

Our investigators show a net loss to the railroad of $611,268. They applied railroad rates to the service hours performed on track and roadway by contract forces and compared the results with the total cost to the road for contractor's services exclusive of wages of track and roadway foremen and compensation insurance, which items it would have borne had it carried the men on its own roll.

The compilations are not on exactly the same basis and we cannot reconcile the results, but the infirmities of the railroad's calculations above pointed out are sufficient to justify our refusal to be guided thereby. The payment to a labor contractor of 10 per cent of the monthly earnings of its track and roadway laborers, including supervisory forces and camp and commissary help, as long as such employees remain in the service has not been justified on this record and has been shown to have resulted in substantially greater expenditures than would have been necessary had it handled this work with its own organization or in fact had the usual fees allowed labor agents for similar work been paid. And it is significant that during the five-year period covered by this investigation the yearly average number of men on the contractors' rolls increased from 303 to 1125 and in percentage from 35 to 71, with a corresponding increase in the allowance to the contractor, whereas during the same period there was an equivalent decrease in the number of men actually carried on the railroad's rolls although the record conclusively shows a substantially greater cost per effective labor hour for the men on the contractors' rolls. Further, the practice of entering into verbal understandings covering such extensive operations and involving the expenditure of more than six millions of dollars, a substantial portion of which the contractors receive under cost-plus agreements, presents such a fertile field for excessive allowances, overcharges, duplication of charges, misunderstandings, and possible future litigation that it cannot be regarded as consistent with efficient and economical management. Whatever may have been the justification for this in the beginning under conditions which then existed, the facts of record do not justify its continuance.

What's the Answer?

What Our Readers Have to Say on Current Questions That Perplex Those Engaged in Maintaining Tracks, Structures and Water Supply Facilities

QUESTIONS TO BE ANSWERED IN THE APRIL ISSUE

1. *What conditions tend to accelerate the rusting of track fastenings, aside from brine drippings? What can be done to counteract these tendencies?*

2. *In placing anchor bolts for posts on concrete structures should they be installed by template as the concrete is deposited or should holes be drilled to receive them when the railing is set?*

3. *When new rail is to be laid, should the tie renewals be made before or after the rail is laid?*

4. *In view of the widespread use of electricity, is it good practice to wire new stations for electric light at points where current is not yet available?*

5. *Is it desirable to advise foremen as to the maximum loads to be placed on motor cars? How can this information best be transmitted where cars of various load-carrying capacities are used on the same road?*

6. *What precautions should be taken to avoid irritation of the skin when handling lime or soda ash at water treating plants? What remedies will relieve such irritation?*

7. *What is the best method of establishing a uniform ballast toe line? Will the method vary for different kinds of ballast?*

8. *What are the relative merits of angles and T-rails as inside guard rails for bridges?*

Track Maintenance During Freezing and Thawing Weather

What special precautions should be taken in the maintenance of main tracks during alternate periods of freezing and thawing?

Close and Frequent Inspection Is Essential

By G. M. O'Rourke
Roadmaster, Illinois Central, Carbondale, Ill.

Frequent and close inspection is the most important precaution to be taken in the maintenance of main tracks during alternate periods of freezing and thawing. The conditions to be looked for are as follows: Heaving track; gage; contraction at switch points, and soft spots.

Heaving can sometimes be prevented by "bleeding" joints, i.e., by cutting the shoulder of the ballast away to draw the water from under the track. The shearing of bolts can be prevented by a careful adjustment of expansion and the application of rail anchors before periods of freezing and thawing. Interference at switch points can be minimized by excavating between the ties under the points and rails to provide drainage and to keep heaving ballast away from the bridle rods and by the proper application of a sufficient number of rail anchors to prevent the separation of the point and stock rails. Switch heel fillers are helpful in maintaining a good fit at the points.

During alternate periods of freezing and thawing there is great danger of wide gage and extraordinary precautions must be taken to maintain proper gage by immediate action following frequent inspection. At such times notes should be made of places where the drainage is inadequate so that the necessary ditching and tiling can be done during the summer.

As a last resort, the speed of trains should be reduced. No chances should be taken that may jeopardize traffic. Where rough track commences to show up and it is realized that repairs cannot be made at once, slow orders must be put out and caution signals displayed.

Little Can Be Done with Deeply Frozen Roadbed

By Bernard Blum
Engineer Maintenance of Way, Northern Pacific, St. Paul, Minn.

During the periods of freezing and thawing in the Northwest, it is generally true that the roadbed contains deep frost. Periods of freezing and thawing generally occur in the early spring, although such conditions also occur during the so-called January thaw.

With deeply frozen roadbed, our experience indicates that there is little work that can be done or that requires special attention. One important matter that must be given close supervision is the cleaning out of culverts to keep them open to carry off the water resulting from the thaws, as there is frequently a tendency for ice to build up in water ways and culverts, where the fall is not great. Where culverts become filled up from heavy snows, these openings do not melt out as quickly and washouts may occur.

It is customary in a country of snow and cold weather to skeletonize turnouts at frog and switch points to permit free drainage for melting snow and ice. During such

periods it is essential that the turnouts be kept clean and the small surface water courses kept open. Otherwise, there will be the possibility of snow and ice building up and preventing the free use of tracks.

Another item to be watched, while not primarily part of the track work, is the care and operation of motor cars. Water-cooled engines must be drained at night and a few warm days must not cause the foreman to forget the freezing at night.

Such Conditions Affect All Parts of the Track

By V. H. Shore

Yard Foreman, Atchison, Topeka & Santa Fe, Dodge City, Kan.

Marked changes of temperature with alternate freezing and thawing affect every part of the track structure. The principal things to be watched are the rails and fastenings, gage and surface. Close watch should be kept for broken rails as breaks occur more frequently at such times; the bolts are also more liable to break, due to the alternate expansion and contraction, and the surface of the track is sometimes affected seriously where there is considerable moisture in the ballast and roadbed on account of improper drainage. This condition is often the cause of switch points getting out of adjustment, necessitating careful and frequent inspection.

Are Flue Linings Worth While?

Is it worth while to install flue linings in the chimneys of stations and other railway buildings where they are are not required by ordinance?

Flue Linings Should Always Be Used

By F. C. Huffman

Assistant Chief Engineer, Chicago & North Western, Chicago

The Chicago & North Western invariably specifies flue linings in chimneys for stations and other railway buildings, regardless of ordinance requirements, as it is felt that the small additional cost is more than offset by the advantages gained; i.e., decreased fire hazard, a smooth smoke flue, and a better job all around. A permanent inspector is seldom assigned to these building jobs, and by specifying flue linings, a good chimney is assured.

Flue Linings Have Several Advantages

By W. T. Dorrance

Designing Engineer, New York, New Haven & Hartford, New Haven, Conn.

Lining should be installed in all chimneys for the following reasons:

1. It gives a smoother surface than an unlined chimney, thereby eliminating the collection of soot.
2. It decreases the fire risk due to less soot collecting on the inside of the chimney.
3. It permits the outside walls to be 4 in. less in thickness.
4. It gives a better draft than an unlined chimney.

Flue Linings Reduce the Fire Hazard

By General Inspector of Buildings

Vitrified tile or fire clay flue linings in chimneys of stations or other railway buildings are a valuable detail of construction since they afford protection against fire at a small cost and in addition improve the draft by presenting a smooth surface to the ascending smoke and gases. This latter quality also lessens the likelihood of the collection of soot in the flue and thus reduces the chance of the chimney burning out, which is a prolific cause of fires.

The mortar is apt to deteriorate more quickly in a chimney than in any other part of the structure, due to its being subjected to heat and it is not uncommon to find old unlined chimneys in which the mortar has loosened and disintegrated to a point where a considerable fire hazard exists. After the construction of a building these conditions are difficult to detect and for the same reason it is usually impossible to remedy matters without tearing down the chimney and rebuilding it. This is a very expensive procedure and one that can be avoided by installing flue linings at the time the chimney is built.

Prevent Fires and Strengthen the Chimney

By P. Aagaard

General Building Inspector, Illinois Central, Chicago

Flue linings should be used regardless of whether they are required by ordinance. A chimney constructed without a flue lining is almost certain to become a source of danger. Constant heat from the fire and the action of the weather cause the mortar to become dry so that it falls out of place, leaving holes or cracks in the chimney; settling also will cause cracks. Being out of view, the cracks and holes cannot be detected until a fire shows the defect and it is then too late to make amends. The time to use care is when the chimney is constructed and the careful method is to use flue lining in every case.

Flue lining serves as a fire preventive and provides a straight flue of uniform dimensions, insuring better draft and eliminating leakage. With flue lining, there is a smooth inner surface, which presents no lodging place for soot, thus practically eliminating the possibility of chimney fires. The cost of flue linings is very small and they are a cheap, practical method of preventing fires and strengthening the chimney.

Water Barrels on Bridges

Should the maintenance of water barrels on bridges be looked after by track or bridge forces?

Should Be Watched by the Track Forces

By C. T. Dike

Engineer of Maintenance, Chicago & North Western, Chicago

Water barrels should be installed and renewed by the bridge men, the condition of the barrels being part of the responsibility of the bridge department. However, the barrels should be given the same attention by the section men as they give to bridges in making their track inspection. If a section foreman finds a barrel that is leaking or has been damaged he should report it so that a new one can be furnished and installed by the bridge or section forces as may be most convenient. The matter of keeping the barrels filled with water should be the responsibility of the section men.

Section Forces Can Give This More Attention

By W. L. Sitton

Chief Engineer Maintenance of Way and Structures, Southern, Lines East, Charlotte, N. C.

This should be handled by the section forces rather than by bridge forces, as section forces pass over structures frequently and can easily find out whether anything is wrong. On our railroad, we have a surplus of empty road oil barrels, which are available for this purpose, and all the section foreman has to do is to ask the supervisor for the necessary barrels and set them

in place when received. We do not feel justified in spending any appreciable amount of money repairing existing barrels, as we have so many empty road oil barrels in surplus.

The Mexican as a Track Laborer

How do Mexicans compare with other classes of track labor? Do they possess the qualities to fit them for skilled work, or as foremen?

Mexicans Are Good Track Laborers When Treated Properly

By F. T. Beckett
District Engineer Maintenance of Way, Chicago, Rock Island & Pacific, El Reno, Okla.

We work a large number of Mexicans in the South and Southwest, particularly in the latter region. In Louisiana, Arkansas and Eastern Oklahoma, we work many Negroes, while on other portions of the Rock Island in Missouri, Kansas, New Mexico and Northwestern Oklahoma, we use "white" labor to a large extent, this class embracing most of the nationalities found in the Middle West.

Mexicans make good laborers after they have been in this country long enough to become acclimated and measurably familiar with our methods of doing work and a number of them, who have the proper qualifications, are made foremen. The percentage capable of being advanced to foremanship is considerably less than among the white race and is about the same as among the Negroes. As to their capability in skilled work, it may be said that we have a considerable number working as machinists and handy men in our shops.

As a rule the Mexican is not as strong or as well adapted to heavy physical labor as is the Negro in his native region, but he adapts himself to the advantages obtainable in this country and becomes a good laborer when properly housed and cared for.

Many Mexicans Are Satisfactory as Foremen

By W. M. Jaekle
Assistant Engineer Maintenance of Way and Structures, Southern Pacific, San Francisco, Cal.

Approximately 90 per cent of our track laborers, including foremen, are Mexicans and we find them satisfactory as track laborers. The Mexican is not a radical in the slightest respect; his outlook on life is happy and he is easily controlled by those in authority. He takes orders cheerfully and in a considerable number of instances develops an understanding that is capable of mastering mechanical trades. It is men of this latter class that we use as foremen.

Those Born in This Country Are to Be Preferred

By M. W. Michel
Roadmaster's Clerk, Southern Pacific, Merced, Cal.

As a rule the Mexicans coming to this country are illiterate and do not have the ambition to study and thus fit themselves for other than common labor. In many cases where the younger and brighter of these men are selected as foremen they do fairly well but they do not always understand the instructions given them by the roadmaster, even though they pretend to understand, which results in their doing work other than that which they were told to do. In most cases they detest reading or writing and it is difficult to obtain satisfactory reports from them or to get them to answer correspondence, even when it is of an urgent nature.

On the other hand, the Mexicans who are born in this country and have had the advantage of the public schools make good foremen as they understand what is wanted and take a keen interest in trying to do the work as it is outlined to them, following the roadmaster's instructions without question, which is more than some of the other classes will do. Some of the Mexicans who come to this country in their twenties make up their minds to stay and to obtain promotion in track work. These attend night school and otherwise fit themselves so they become good foremen. The main point is to select the ambitious ones while they are young and train them so that they will be fitted for foremen when they have had the required experience. When this is done the Mexican compares favorably with other classes of labor.

Height of Guard Rails

What, if any, advantages are gained by using guard rails which extend above the top of the running rail on sharp turnouts? What should be their maximum height above the running rail?

High Guard Rails Tend to Prevent Derailments

By J. B. Strong
President, Ramapo-Ajax Corporation, New York

Guard rails higher than the running rails have been used extensively, particularly for sharp angled turnouts and on sharp curves. It is a well known fact that engine pony truck wheels will climb when the side thrust is greater than the weight of the truck, and observations have established that in many cases pony truck wheels on the inside of a curve are raised as much as ¾ in. off the running rail. This condition tends to allow the wheel flanges to climb over the top of the guard rail, and whenever this happens in a facing movement there is a tendency for the locomotive to derail at the point of the frog. The use of guard rails ¾ in. higher than the running rails will prevent wheels climbing in practically all turnouts in common use, but in some cases we have found a greater height desirable.

We have furnished thousands of guard rails ½ in. to ¾ in. higher, and a considerable number 1 in. higher than running rail, while in a few exceptional cases they were furnished 1½ in. higher. So far as we know these high guards have never caused any trouble. The American Railway Engineering Association has not established any maximum height for guard rails, although it has established a maximum height for flange guards on self-guarded frogs at 1¼ in. above the top of the running rail, which is an ample maximum height to consider for guard rails, except in extreme cases where a height of 1½ in. has been furnished as noted above.

High Guard Rails Prevent Derailments

By E. D. Swift
Engineer Maintenance of Way, Belt Railway of Chicago, Chicago

High guard rails are particularly effective in preventing wheels from climbing rails in circumstances where a combination of curvature and equipment approaches practical limitations. The writer's earliest experience with such guard rails was soon after the development of one-piece cast guard rails about 15 years ago, when a guard rail 6 in. high was installed in a terminal switch laid with 5-in. rail, on which had occurred a number of derailments of large locomotives equipped with two-wheel pilot trucks. These derailments always

occurred in facing movements through the switch and were due to the pilot truck wheel on the guard rail side mounting the guard rail at a point opposite the interval between the throat and the point of frog.

Investigation seemed to indicate that a contributing factor in these derailments was the tendency of the wheels to mount the guard rail when the lateral restraint of the rail against the wheel flange was released on the frog side of the switch while the wheel was passing through the interval between the throat and the point of frog. The use of a high guard rail stopped these derailments and high guard rails have been used with equal success in many similar circumstances since that time.

Removing Old Trestle Piles

When a trestle bridge is renewed by driving new bents, how close to the ground should the piles in the old bents be cut off?

Should Be Cut Off as Close to Ground as Possible

By E. A. Frink

Principal Assistant Engineer, Seaboard Air Line, Savannah, Ga.

Since the form of the question precludes consideration of the renewal of trestles by stubbing on old bents, consideration is confined to those trestles which are renewed by driving new pile bents.

There are two classes of trestles to be considered, one over water and the other over land which may or may not be subject to floods at times. In the case of trestles over water the piles should be cut off, first to remove additional fire hazard, and second to free the structure from decaying timber. If the waterway is subject to flood and consequent accumulation of drift, the piles should be pulled or cut off as close to the ground surface as possible. If there is no flood hazard they should be cut off as close to the water level as practicable. In the case of trestles over land that is unusually dry or not flooded, the piles should be cut off flush with the ground to remove additional fire hazard and the decaying timber.

Better to Err on the Side of Safety

By Division Engineer

Ordinarily the piles in the old bents of a renewed pile trestle should be cut off as close to the ground as possible when they are not in the stream, and when they are located in the water they should be cut off to a point where they will not form obstructions to catch drift or ice in case of freshets. In some cases, even where there is no likelihood of their causing obstructions to the flow of the stream, it is economical to remove them to a point well below the ordinary level of the water as an insurance against damage suits. This is particularly true where the stream lies within a drainage district, for in case of floods the first cause of overflow on land above a railroad bridge is insufficient waterway at the bridge—in the minds of the owners of the flooded land. The writer recalls two such cases in his experience, where heavy damages were claimed on this account and where surveys showed clearly that the bridges had nothing to do with the case. In one instance the matter was settled out of courts, and in the other the railroad won the suit, but the costs of making the surveys and of preparing the cases for the trials amounted to considerably more than that of removing the piles to the bed of the stream—and in the first of these cases a stipulation in the agreement called for the removal of the piles. In such damage suits it is well to recall that the case is usually heard where the inhabitants have a vital interest in obtaining a decision against the railroad, and pile stubs in a stream afford a most convenient pretext on which to hang a verdict.

Are "Snow Cuts" Worth While?

Where snow conditions are bad is it worth while to flatten the slopes of shallow cuts and to widen the deeper cuts with steam shovels to prevent their becoming blocked by snow?

This Practice Is Well Worth While

By J. V. Neubert

Chief Engineer Maintenance of Way, New York Central, New York

The practice of flattening the slopes of shallow cuts and of widening the deeper cuts is worth while where snow conditions are bad. On our lines we have two conditions in fighting snow; one, such as on our Adirondack division in the mountains, where winds do not prevail, and the other on our Rome, Watertown and Ogdensburg division along Lake Ontario, where we have snow accompanied by winds which cause it to drift. The first condition can be combated with ordinary equipment, while the second requires a hard battle to overcome.

All cuts, either light or heavy, where the latter conditions prevail, should be widened. If the cuts are narrow the snow drifts into them and they soon become clogged after the passage of a few trains, while if the cuts are wide and somewhat sloped there will be room for working the snow back clear of the track. One of the best indications of the value of this is found in the extensive widening of cuts we have done on the R. W. & O. division as well as in the same territory where we have double track, which, of course, widens the cut sections, and where our snow fighting on the double track does not compare with that on the single track sections.

Depends on Density and Importance of Traffic

By R. G. Kenly

Chief Engineer, Minneapolis & St. Louis, Minneapolis, Minn.

The method of handling snow must be divided into two parts: The question of operating costs as reflected in the carrier's financial statement and the necessity for rendering service to a community as a common carrier.

Discussing the first question, density of traffic must be a governing point. On light traffic lines it is my opinion that snow fighting equipment, steel plows on engine pilots, wedge plows mounted on standard equipment, such as heavily loaded ballast cars or gondolas, Russell snow plows and rotaries will prove less expensive in maintenance and operation than the interest on the cost of creating wide snow cuts over a considerable territory and flattening down shallow cuts. Assuming that it is not necessary to undertake to keep a railroad open during a snow storm, the snow fighting equipment need not be called into service until the storm has abated; it is our opinion that the railroad's financial situation will be best met in this way, and that no serious inconvenience can result in either passenger service or freight service to the community through which the railroad operates for the time the railroad is blocked by ordinary storms.

In the case of heavy tonnage lines, the financial interest of the railroads takes on so much larger proportions

that their operating necessities take precedence over the immediate consideration of public service; that is to say, the financial interest of the railroad impels it to spend more money to maintain its service rather than the compulsion of serving the community, the community reaping the benefit, however, of the railroad's operating necessity. Therefore it seems preferable that the first cost of widening cuts and providing large space in which to hold accumulating snow drifts offers the better solution of the snow fighting problem, than to attempt to open the road with snow fighting equipment after it shall have been blocked. However, the widening of cuts is only an incident in the remedy as one gets into the region of heavy and frequent storms; snow cuts, from one to one-half dozen lines of snow fence, on up to the necessity of snow sheds, complicate the problem, and make an answer to this question most difficult.

Should Be Done on Important Lines

By V. H. Shore

Yard Foreman, Atchison, Topeka & Santa Fe, Dodge City, Kan.

The importance of the line should be taken into consideration before heavy expense of this nature is incurred. Main lines with heavy or fast traffic should be protected by every means that will insure a minimum of delay to train movements by drifting snow. Flattening the slopes of shallow cuts to an angle of 45 deg. or less from the horizontal will cause most of the snow from ordinary storms to be blown clear of the cut .

Widening the deeper cuts has proved advantageous by increasing greatly the time that it takes the snow to fill the cut and in most cases where this is done little trouble will be experienced since ordinarily severe snow storms are over in 36 hours or less. If deep cuts have a width of 30 ft. from the center of the main track, delays due to snow in cuts will be reduced to a minimum. Almost without exception the material obtained from flattening the slopes or widening the cuts can be used to advantage without long hauls.

Water Service Work in Winter

What water service maintenance or betterment work can be done advantageously in the winter?

Frozen Earth and Ice Are Often Aids to Work

By E. M. Grime

Engineer Water Service, Northern Pacific, St. Paul, Minn.

Handling any kind of water service work during winter weather might seem to be impracticable, but there are often some features of this service which can be taken care of to the best advantage at this season of the year. Of course, there will be days of severely cold weather when no outside work should be attempted, but this discussion relates to average winter temperatures of about zero and above.

Pipe lines extending across yard tracks, especially where they cross at an acute angle and under switches, where it would be necessary either to abandon operation of the tracks or place timber supports and where it would also be difficult to open up trenches between tracks, can be laid to best advantage after there is about three feet of frost in the ground. This thickness of frozen earth is sufficient to prevent caving and will usually permit of tunneling under several tracks at a time.

Adequate backfilling in this case is somewhat more expensive than with ordinary open trench work, and some resurfacing of the tracks may be necessary when the frost goes out, but this is more than offset by less total excavation, absence of expense for timber track supports, less interference with yard switching operations, and increased safety to trainmen and others by reason of fewer openings and obstructions between the tracks.

An intake pipe line extending into a river or reservoir, especially if it ends in a gravel-filled filter box, is another type of work that can usually be handled to the best advantage during the winter season after a heavy layer of ice has formed. The working bed formed by the ice is a distinct advantage, and in a river this is likely to be the time of low water, when the stream bed may be reached with the least difficulty and expense.

Freedom from wave action and better control of a swift current are other advantages of the ice cover. Also, where the pipe lies in low and water-soaked ground, the flow by reason of ground water seepage is usually less and more easily controlled after the frost has penetrated the ground. Soundings to determine the contour lines of rivers or lakes are also an incidental feature of this class of work that can be handled most conveniently from the surface of the ice.

The artificial freezing of soft, water-bearing material has sometimes been found desirable in difficult and deep under-water foundation work. In a small way the water service engineer is taking advantage of this principle when handling some of his more difficult work during the winter season.

Much Water Service Work Can Be Done in Winter

By Water Service Inspector

It is assumed that this question refers specifically to roads in northern climates where snow and ice may interfere with the prosecution of certain kinds of work in the water service department. On this basis it may be said that with some few exceptions, such as exterior painting, and the laying of pipe lines on land or other work involving the handling of earth, almost all kinds of water service work may be done as satisfactorily in the winter as in the summer if proper precautions are taken.

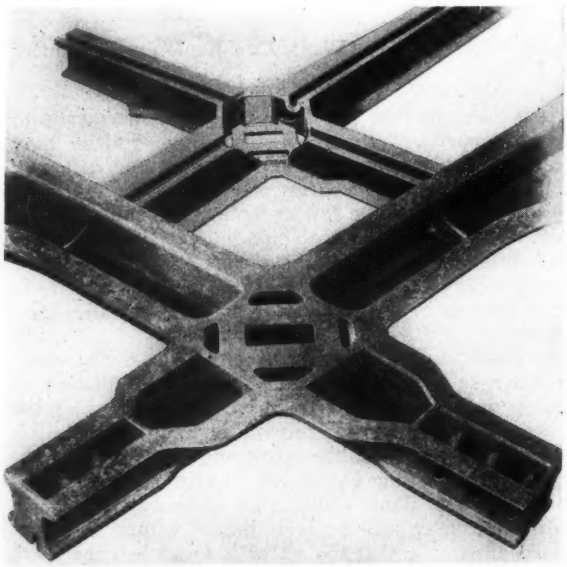
In many cases the laying of pipe lines under water or other subaqueous work such as the installation of intakes may be carried on more cheaply during the winter than at other seasons of the year since the ice affords a support for the work and thus obviates the necessity of floating equipment. Certain kinds of masonry dams or dams constructed of timber cribs filled with stone may also be built in the winter, with the added advantage that the water is low when the work is done. Earthen dams should never be built when there is frost in the ground, not only because the work will cost a great deal more, but because a dam built under such circumstances would not be satisfactory.

Repairs or changes in pumping machinery which do not involve changes in the delivery line, interior repairs and painting, and many exterior repairs to pump houses can also be made economically in the winter. In adopting the policy of winter work it is important that it be programmed and carried out so that fairly uniform forces may be maintained throughout the year, thus avoiding the necessity of "breaking in" new men at the beginning of each season. The cost of labor turnover is greater than is usually realized and on roads with large annual water service programs, the practice of so arranging the work that it can be done throughout the year will effect real savings.

New and Improved Devices

Crossing Design Based on Scientific Studies

A NEW crossing, designed along scientific lines, after a prolonged study and investigation of the stresses set up in crossings by train movements has recently been developed and put on the market. This crossing incorporates a number of new features of design. It provides for a uniformity in the metal sections under the tread and groove surfaces, an advantageous feature which became evident early in the investigation. There



Views Showing New Features of the Crossing

are no supporting members joining the under side of the tread and groove metal, thereby eliminating the danger of shrinkage cavities and heat treatment defects in the metal surrounding the intersection of the gage lines. A bottom grid or floor beneath the intersection of flangeways forms a hollow box-like structure at this point, which is said to give the crossing resiliency and strength, while avoiding excess weight.

Cross members in the arm sections of the crossing form a strong tie to prevent the side walls from spreading, but these members do not come in contact with the under side of the tread or groove surfaces, and thus avoid the possibility of interior defects which so frequently caused cupping in the tread surface. The side walls of the crossing are tapered, being thicker at the top where they join the under side of the tread and guard sections. This feature was incorporated to decrease the unit stresses in the groove section and to permit a gradual transition of metal sections, from the thick tread to the thin outer flange of the base.

This new crossing is being manufactured by William Wharton Jr. & Co., Inc., Easton, Pa., which, for a period of four years, has been engaged in the scientific investigation of manganese crossing design. All of the above mentioned features of the crossing were incorporated in the new design in accordance with the findings established by this investigation. The investigation surrounding the new crossing was made from two major viewpoints. First, to create a design which would afford minimum unit stresses in the structure when subjected to service conditions; and second, to determine just what sections could be cast and heat treated with the assurance that the metal would be sound throughout.

In arriving at the new features of this crossing, Beggs method of analysis of stresses was followed, using a Beggs deformeter, and studying the resulting stress reactions under the microscope. The findings in these studies were checked by Professor Mortimer F. Sayer of Union College, employing his photo-elastic model method of polarized light analysis, and his results varied but little from those obtained in the Beggs analysis.

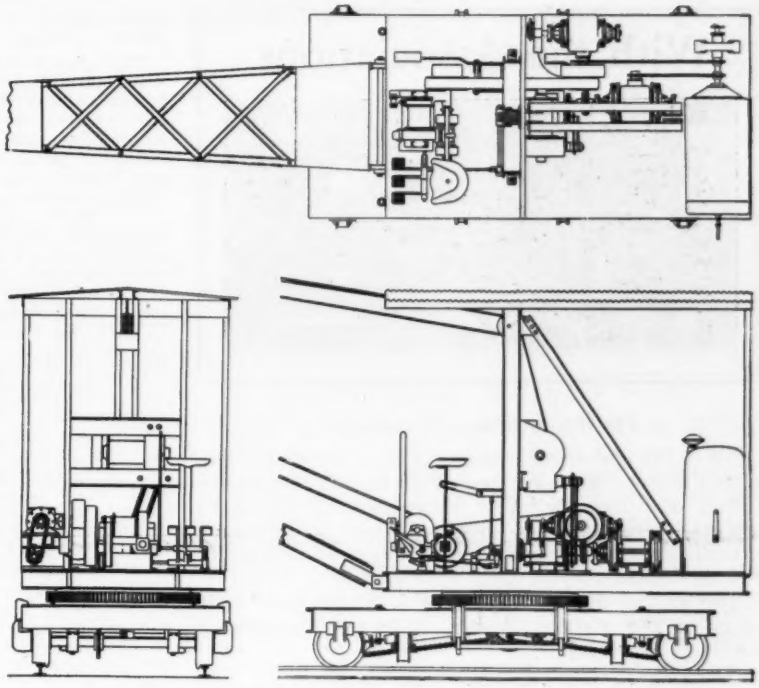
A Track Crane with New Features

THE NORDBERG Manufacturing Company, Milwaukee, Wis., has developed and placed on the market a self-propelled track crane of new design in which several features unusual in this type of equipment are incorporated. The machine, which is known as the Nordberg Trackrane, is especially adapted for use in relaying rail and for loading or unloading rail and other materials handled by the maintenance forces, as well as hauling trailers for the transportation of men and materials.

The crane is full revolving in either direction, the platform being mounted on a ball bearing turntable which is driven by a pinion meshing with a ring gear attached to the rim of the turntable and actuated by a worm gear controlled by a reversible friction disk clutch. This feature permits the crane to be mounted on a flat car between other cars and to load or unload two cars before switching, thus reducing the switching to one-half of what would be required if the crane could work from end of the car only. It also obviates the necessity of men riding under the boom when the crane is used to haul gangs on trailers to and from their work.

The frame of the car is 12 ft. 8 in. long by 6 ft. wide, while the platform is 10 ft. 9 in. long by 6 ft. wide, both of these structures being built up of channels and plates with welded joints. Power is supplied by a 40-hp., 4-cylinder gasoline engine and the car has two speeds in each direction. The crane has a capacity of 5,000 lb. with hoisting speeds of 90 ft. and 180 ft. per min. The boom, which is of the channel, plate and lattice type, has a normal length of 26 ft. 6 in., but can be extended readily to 35 ft.

Particular attention has been paid to the prevention of accidents due to carelessness or negligence on the part of the operator. The hoisting drum is driven by a worm gear, through a multiple disk clutch, all thoroughly enclosed, and little effort is required for the operating lever, which is so arranged that it returns immediately to a neutral position on being released. A safety brake is provided which is applied automatically the moment power is released from the drum, the braking effort being always proportional to and greater than the load. The lowering of the load is performed by power and is not dependent on the brake under normal conditions. All control levers are located conveniently for the operator, who is placed so that he has a full view of the work.



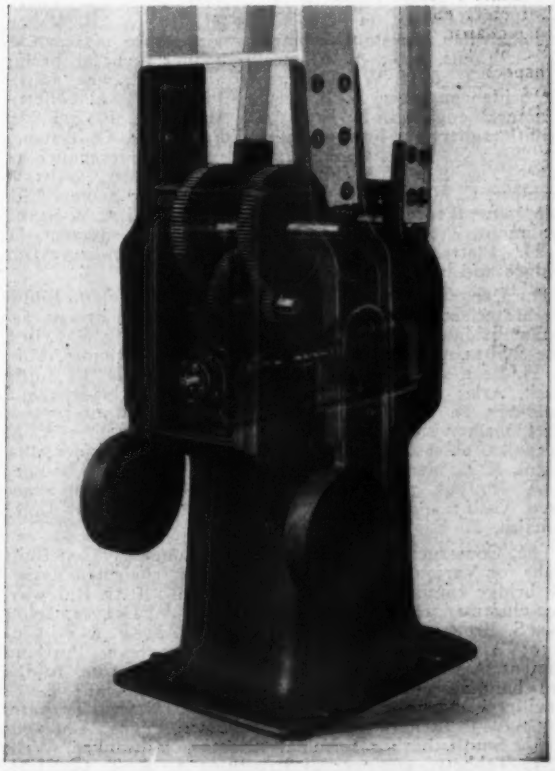
Plan and Elevations of the Nordberg Trackrane

The car is equipped with automatic brakes for all four wheels, so arranged that they are applied whenever the operator releases pressure from the traveling pedal. Rail clamps are provided for securing the crane to the track when the weight of the load requires it, and small transverse wheels permit the machine to be removed quickly from the track at set-offs between stations.

Electrically-Operated Crossing Gate

THE application of modern machinery practice to one of the oldest of railway appliances has been carried out in a new design of highway crossing gate. This gate is operated by electrical power through a remote push-button control such that any number of gates may be operated by a single watchman. The power unit is a General Electric, ½-hp. reversible type motor, operating at 1800 r.p.m. which transmits its power to the crossing arm through a worm gear drive and spur gears which afford the necessary speed reduction. While this piece of equipment contains a considerably larger number of moving parts than the older type of gate, as will readily be seen in the phantom view, the machinery is constructed to operate with a minimum of attendance. It is housed in a substantial box frame and all moving parts are designed for long service operation. High grade cut gears are used, bronze bushings are provided for bearings and the worm drive runs in an oil bath. The gear reduction provides for the movement of the gate arms through the full 90-deg. arc in from 4 to 4½ seconds.

The push-button control is actuated through the use of reversing type magnetic circuit breaker and controller of simple and substantial construction, with electrical and mechanical interlocking features. The motor is brought to a stop at the end of the movement for either opening or closing the gate by means of a limit switch which is designed to eliminate destructive arcing. This gate is sold by Foote Brothers Gear and Machine Company, Chicago.



Phantom View of the Housing of the New Crossing Gate

With the Associations

The Engineering Association

All of the committee reports to be presented at the March convention have been delivered to Secretary Fritch and four bulletins, containing 20 of these reports, were mailed to members prior to February 1, while another bulletin, with the remaining reports will be mailed shortly after that date.

The annual dinner will be held in the grand ball room of the Palmer House, Chicago, Wednesday evening, on March 7.

Bridge and Building Association

Owing to a conflict in hotel arrangements at Boston, the next convention has been postponed one week and will be held on October 23-25. The Hotel Statler has been selected as headquarters.

The following committees have been selected to study and report at the next convention:

The Relative Merits of Jacking or Tunneling Through a Roadbed Under Traffic as Compared with Other Methods of Placing Culvert Pipe: F. H. Masters, chairman, assistant chief engineer, E. J. & E., Joliet, Ill.; W. H. Vance, vice-chairman, assistant engineer maintenance of way, M. P., St. Louis, Mo.; A. E. Bechtelheimer, general bridge inspector, C. & N. W., Chicago; Frank H. Cramer, assistant bridge engineer, C. B. & Q., Chicago; L. A. Gillette, structural engineer, F. E. C., St. Augustine, Fla.; F. M. Griffith, supervisor bridges and buildings, C. & O., Covington, Ky.; B. M. Hudson, superintendent maintenance of way, T. & B. V., Teague, Tex.; Peter Jenny, assistant engineer, C. M. St. P. & P., Milwaukee, Wis.; Samuel Lincoln, general foreman bridges and buildings, G. C. & St. F., Beaumont, Tex.; W. J. H. Manning, division engineer, D. & H., Plattsburg, N. Y.; and G. A. Purdy, supervisor bridges and buildings, M.-K.-T., Denison, Tex.

The Use of Motor Trucks for Handling Bridge and Building Materials and Supplies: J. S. Huntoon, chairman, assistant bridge engineer, M. C., Detroit, Mich.; G. S. Crites, vice-chairman, division engineer, B. & O., Baltimore, Md.; H. H. Best, supervisor bridges and buildings, M. P., Little Rock, Ark.; Eldridge E. Candee, supervisor bridges and buildings, N. Y., N. H. & H., New Haven, Conn.; A. J. Hart, master carpenter, A. C. & Y., Akron, Ohio; A. A. Kurzejka, chief carpenter, C. M. St. P. & P., Minneapolis, Minn.; E. L. Mead, division engineer, C. & N. W., Chicago; D. T. Rintoul, general bridge inspector, S. P., San Francisco, Calif.; and C. W. Wright, master carpenter, L. I., Jamaica, N. Y.

The Construction and Placing of Concrete Unit-Built Slabs for Various Purposes: H. A. Gerst, chairman, assistant bridge engineer, G. N., St. Paul, Minn.; A. O. Ridgway, vice-chairman, chief engineer, D. & R. G. W., Denver, Colo.; Van S. Brokaw, assistant engineer, C. M. St. P. & P., Chicago; A. C. Irwin, manager railways bureau, Portland Cement Association, Chicago; George C. McCue, bridge and building master, C. N. R., Hamilton, Ont.; E. C. Neville, bridge and building master, C. N. R., Toronto, Ont.; A. J. Richards, assistant engineer, Penna., Chicago; C. U. Smith, harbor terminal director, Milwaukee, Wis.; G. E. Tebbetts, engineer of structures, C. R. T. Co., Chicago; M. E. Thomas, division engineer, C. & N. W., Boone, Iowa, and E. E. R. Tratman, editor, Engineering News-Record, Chicago.

The Control of Motor Car Operations with Respect to the Prevention of Accidents: W. A. Batey, chairman, general bridge and building inspector, U. P., Omaha, Neb.; F. W. Hillman, vice-chairman, assistant engineer maintenance, C. & N. W., Chicago; C. E. Brightwell, supervisor water service, C. & O., Huntington, W. Va.; C. H. Collier, bridge and building foreman, S. P., Marshfield, Ore.; Geo. M. Haley, supervisor bridges and buildings, U. P., Salt Lake City, Utah; F. G. Hawken, general foreman, D. S. S. & A., Marquette, Mich.; M. D. Jones, bridge and building foreman, Y. & M. V., Greenville, Miss.; C. R. Knowles, superintendent water service, I. C., Chicago; C. G. Lindstrom, bridge and building foreman, C. M. & St. P., Rockwell City, Iowa; A. V. Rohweder, supervisor safety, D. M. & N. and D. & I. R., Duluth, Minn.; and F. J. Welch, chief carpenter, C. M. St. P. & P., Tacoma, Wash.

Organization and Equipment for Handling Emergency Bridge, Building and Water Service Work: C. D. Turley, chairman, supervisor of track, I. C., Chicago; H. I. Benjamin, vice-chairman, assistant division engineer, S. P., San Francisco, Calif.; W. M. Cardwell, supervisor bridges and buildings, Washington Terminal Company, Washington, D. C.; F. M. Case, foreman water service, C. & N. W., Sioux City, Iowa; F. P. Farrell, supervisor water service, M. P., Pueblo, Colo.; A. I. Gauthier, supervisor bridges and buildings, B. & M., Concord, N. H.; J. B. Livingston, supervisor bridges and buildings, St. L. S. W., Illmo, Mo.; H. C. Munson, instrumentman, C. M. St. P. & P., Chicago; W. V. Parker, foreman bridges and buildings, St. L. S. W., Paragould, Ark.; R. E. Sheehan, supervisor bridges, C. B. & Q., Chicago; and M. G. Tribe, master carpenter, Erie, Salamanca, N. Y.

Recommendations for Promoting Co-operation Between Store Department and Field Forces: L. M. Bates, chairman, division engineer, C. & N. W., South Pekin, Ill.; G. T. Richards, vice-chairman, district storekeeper, C. M. St. P. & P., Minneapolis, Minn.; W. A. Hutcheson, assistant supervisor bridges and buildings, C. & O., Clifton Forge, Va.; J. E. King, general supervisor bridges and buildings, C. & O., Richmond, Va.; R. W. Mitchell, general foreman, B. & O., Baltimore, Md.; C. A. W. Musson, division engineer, C. M. St. P. & P., Seattle, Wash.; A. W. Reynolds, assistant master carpenter, Penna., Jersey City, N. J.; Wm. Shively, master of bridges, C. R. R. of N. J., Jersey City, N. J.; T. E. Snyder, acting supervisor bridges and buildings, B. R. & P., East Salamanca, N. Y.; and W. G. Swartz, engineering accountant, C. N. R., Toronto, Ont.

The Economical Operation and Maintenance of Water Stations: R. C. Bardwell, chairman, superintendent water service, C. & O., Richmond, Va.; J. M. Fitzgerald, vice-chairman, office engineer, C. of Ga., Savannah, Ga.; J. M. Cowsert, supervisor water department and motor cars, M. P., Gorham, Ill.; F. M. Lehrman, bridge draftsman, C. & N. W., Chicago; A. L. McCloy, supervisor water service, P. M., Saginaw, Mich.; W. E. Pierce, superintendent water service D. & H., Oneonta, N. Y.; and H. H. Richardson, engineer water service, M. P., St. Louis, Mo.

Painting the Interior and Exterior of Railway Stations, Freight Houses and Allied Buildings: Kemper Peabody, chairman, general supervisor buildings, N. Y. C., New York City; H. C. Archibald, vice-chairman, supervisor bridges and buildings, B. & M., Salem, Mass.; E. H. Brown, supervisor bridges and buildings, N. P., Minneapolis, Minn.; Chas. Ettinger, supervisor bridges and buildings, I. C., Chicago; Thomas E. O'Brien, bridge and building master, D. & H., Carbondale, Pa.; C. P. Rawson, architect, I. C., Chicago; G. A. Rodman, general supervisor bridges and buildings, N. Y., N. H. & H., New Haven, Conn.; and E. P. Self, supervisor of buildings, L. I., Jamaica, N. Y.

The Roadmasters' Association

The following committees have been selected to study and report at the next convention on subjects assigned as follows:

The Care of Winter-Laid Rail: M. J. Nugent, chairman, assistant engineer, D. & H., Albany, N. Y.; A. Chinn, engineer maintenance of way, C. B. & Q., Lincoln, Neb.; J. P. Corcoran, roadmaster, C. & A., Bloomington, Ill.; W. F. Nichols, supervisor, L. V., Buffalo, N. Y.; G. H. Strople, supervisor, B. & O., Callery, Pa.; C. W. Coil, roadmaster, N. P., Helena, Mont.; J. W. Powers, supervisor, N. Y. C., Rochester, N. Y.; and W. A. Davidson, roadmaster, U. P., Kearney, Neb.

The Programming of Section Work: J. J. Desmond, chairman, roadmaster, I. C., Chicago; G. T. Anderson, roadmaster, K. C. S., Heavener, Okla.; P. J. Keenan, supervisor, Erie, Cuba, N. Y.; A. Salinsky, roadmaster, B. R. & P., Salamanca, N. Y.; T. R. Patterson, roadmaster, M. St. P. & S. S. M., Superior, Wis.; P. Chicoine, roadmaster, C. P. R., Smiths Falls, Ont.; F. W. Easton, roadmaster, S. P., Ogden, Utah; and C. Feucht, roadmaster, U. P., Kansas City, Kan.

Methods of Preventing and Overcoming Damage to Rail Ends: C. F. Allen, chairman, division engineer, C. M. St. P. & P., Milwaukee, Wis.; W. H. Jones, roadmaster, A. T. & S. F., Chillicothe, Ill.; W. E. Davin, roadmaster, P. & L. E., Pittsburgh, Pa.; W. P. Wiltsee, chief engineer, N. & W., Roanoke, Va.; D. K. Newmyer, roadmaster, T. & N. O., Houston, Tex.; J. J. Gallagher, roadmaster, M.-K.-T. Mokane, Mo.; and J. A. Roland, roadmaster, C. & N. W., Missouri Valley, Iowa.

The Organization of Track Forces: A. A. Johnson, chairman, track engineer, D. L. & W., Hoboken, N. J.; E. C. Buhrer, supervisor, T. & O. C., Kenton, Ohio; M. H. Murphy, supervisor, C. & A., Mexico, Mo.; Chas. Kratoska, roadmaster, C. & N. W., Ames, Iowa; W. H. Haggerty, roadmaster, N. Y., N. H. & H., Harlem River, N. Y.; W. A. Clark, supervisor, Reading, Trenton Junction, N. J.; I. D. Talmadge, roadmaster, N. Y., O. & W., Middletown, N. Y.; H. B. Vess, editor, Employees' Bulletin, K. C. S., Kansas City, Mo.; and E. P. Safford, supervisor, N. Y. C., Silver Creek, N. Y.

The Conservation of Revenue-Earning Equipment in Handling Maintenance of Way Materials: R. H. Smith, chairman, superintendent, N. & W., Roanoke, Va.; W. O. Frame, engineer maintenance of way, C., B. & Q., Burlington, Iowa; C. W. Baldridge, assistant engineer, A., T. & S. F., Chicago; E. Galvin, supervisor, Penna., Niles, Ohio; W. D. Bagby, roadmaster, St. L. & S. W., Malden, Mo.; G. G. Smart, general roadmaster, G. N., St. Paul, Minn.; H. H. Wise, supervisor, C., C., C. & St. L., Anderson, Ind.; and G. P. Asbury, engineer maintenance of way, Southern, Danville, Va.

The Material Market

THE United States Steel Corporation closed its books on December 31, 1927, with unfilled orders aggregating 3,972,874 tons, a total which represented thae largest increase in any one month during a period of three years. This total also presents the largest volume of unfilled orders since March 31, 1926, and exceeds the low mark in orders on hand during 1927, namely, at the end of May, by 921,933 tons.

This is obviously a reflection of an increase in purchases during December. Consequently it is of interest to note what effects, if any, this had on market trends during the month of January. Foremost among the results was a further advance of $1 per ton in the price of plates, shapes, and bars announced by the Carnegie Steel Company effective January 19, and subsequently adopted by other manufacturers. This is a reflection of a continued demand for structural steel in large volume, in which the railroads are an important factor. Thus, the Pennsylvania has made inquiries for 32,000 tons to cover its equipment requirements, while the Boston & Maine has announced a program for the building of 92 bridges at a cost of $2,050,000 primarily for the purpose of replacing temporary structures required to restore traffic following the disasterous flood in November. Equipment orders placed by the railroads have also exerted an important influence. Orders reported in the Railway Age during January include 51 locomotives, 3,400 freight cars, and 676 passenger cars.

The rate of steel production has also been stepped up and is now estimated at about 75 per cent of mill capacity. Rail output is even higher. Tie plate output is reported at 70 to 80 per cent of capacity at Chicago and track accessories at about 60 per cent.

Some Rail Tonnage Still to Be Placed

While the bulk of the rail requirements of the roads have been definitely provided for, some tonnage is yet to be placed. The Rock Island, for example, has made inquiries for from 40,000 to 50,000 tons, but has not placed orders. In the meantime new orders for rail include 15,000 tons for the Pere Marquette, 13,900 tons for the Central Railroad of New Jersey, 13,800 tons for the St. Louis-Southwestern and an order for 11,500 tons for the Nickel Plate which provides for an optional addition of 7,000 tons. The market for track accessories is active, but computations show that orders have not been proportionate to the purchases of rail, indicating that a considerable increase in business for track fastenings is in sight.

Further increases in the prices of the various classes of scrap are another evidence of an optimistic tone of general business. The January prices for scrap quoted in the table appearing in these columns are higher than those given for December.

Not much change has taken place in the lumber market, except that a considerable increase in orders placed during the week ending January 14 is taken as an encouraging omen. Prices have not been subject to marked changes.

Iron and Steel Prices per 100 lb.

	December		January	
	Pittsburgh	Chicago	Pittsburgh	Chicago
Track spikes	$2.80	$2.80	$2.80	$2.80
Track bolts	$3.80 to 4.00	3.80	$3.80 to 4.00	3.80
Angle bars	2.75	2.75	2.75	2.75
Tie plates, steel	2.25	2.25	2.25	2.25
Boat spikes	3.10	3.10	3.10	3.10
Plain wire	2.40	2.45	2.40	2.45
Wire nails, keg	2.50 to 2.55	2.55 to 2.60	2.55	2.60
Barb wire, galv	3.20 to 3.25	3.25 to 3.30	3.20 to 3.25	3.25 to 3.30
C. I. pipe, 6 in. to 12 in., ton		34.70 to 37.20		34.20 to 36.20
Plates	1.80	1.90	1.80 to 1.85	1.90 to 2.05
Shapes	1.80	1.90	1.80 to 1.85	1.90 to 2.05
Bars, soft steel	1.80	1.90	1.80 to 1.85	1.90 to 2.05
Rivets, struc.	2.75	2.85	2.75	2.85
Con. bars, billet	1.80 to 1.90		1.90 to 1.95	
Con. bars, rail	1.65 to 1.70	1.80	1.65 to 1.70	1.80
Rails, per gross ton, f.o.b. mills	43.00	43.00	43.00	43.00

Scrap Prices per Gross Ton at Chicago

	December	January
Relaying rail (including angle bars)	$26.00 to $31.00	$26.00 to $31.00
Rails for rerolling	14.25 to 14.75	15 00 to 15.50
Rails less than 3 ft. long	14.75 to 15.25	15.25 to 15.75
Frogs and switches cut apart	13.25 to 13.75	14.25 to 14.75
Steel angle bars	13.75 to 14.25	14.00 to 14.50

Southern Pine Mill Prices

	December	January
Flooring, 1x4, B and btr., flat	$37.00	$38.00
Boards, 1x8, No. 1	32.40	31.50
Dimension, 2x4, 16, No. 1, common	23.50	23.75
Dimension, 2x10, 16, No. 1, common	23.89	25.50
Dimension, 2x4, 16, No. 2, common	19.45	20.50
Dimension, 2x10, 16, No. 2, common	20.16	21.00

Douglas Fir Mill Prices

	December	January
Flooring, 1x4, B and btr., flat	$24.25	$23.00
Boards, 1x8, No. 1	16.25	14.75
Dimensions, 2x4, 16 No. 1, common	17.50	17.25
Dimensions, 2x10, 16, No. 1, common	17.25	17.25
Dimensions, 3x3 to 4x12, No. 1, common	18.50	18.50
Dimensions, 5x5 to 12x12, No. 1 common rough	17.00	17.00

Changes in the prices of portland cement include a reduction from $2 to $1.90 per barrel at Detroit. No changes have taken place in the prices at points listed below, which are per barrel in carload lots, not including package:

New York	$2.03	Minneapolis	$2.22
Pittsburgh	2.04	Denver	2.85
New Orleans	2.07	Dallas	2.05
Chicago	2.05	San Francisco	2.51
Cincinnati	2.23	Montreal	1.41

Railway News

Briefly Told

A schedule of 68 hours instead of the present schedule of 70 hours between Chicago and Portland, Ore., and Seattle, Wash., effective May 6, has been announced by the various roads which operate fast through trains between these points.

The application of the Delaware & Hudson for authority to acquire control of the Buffalo, Rochester & Pittsburgh by lease has been denied by the Interstate Commerce Commission by a vote of six to five. The application has been pending since July 16, 1926.

The Chicago, Milwaukee, St. Paul & Pacific took over the property of the former Chicago, Milwaukee & St. Paul on January 14, as a result of the reorganization effected to end the receivership of the latter company, which had existed since March 18, 1925.

Vehicles transporting explosives in Ohio are now required by a state law to come to a full stop before crossing railway tracks. The law applies to all vehicles, whether motor or horse-drawn, and covers, among other commodities, ether, hydro-carbon, turpentine and wet calcium carbide.

Travel to the national parks and monuments in 1927 reached a new high record, according to the annual report of the Secretary of the Interior, the total amounting to 2,797,840. This was an increase of 482,935, or 21 per cent, over the previous high mark, which was established in 1926. Yosemite showed the greatest increase, 226,221.

The effective date of the order of the Interstate Commerce Commission in the St. Louis and O'Fallon recapture case has been postponed to April 30 to allow time for an appeal by that company to the Supreme court of the United States from the decision of the special court at St. Louis which upheld the commission's order without examining into the valuation methods involved.

The Baltimore & Ohio has started a train to make a tour of its system to show moving pictures of its Centenary Exhibition and Pageant to employees and others who were unable to attend the Fair of the Iron Horse at Baltimore. The train consists of two cars, a coach fitted as a moving picture theater and a baggage car containing an electric generating plant and a heating plant. The pictures, which are in four reels, show the pageant in the sequence in which it was produced, from the appearance of the Centenary Band to the finale. An Orthophonic Victrola in the coach plays music selected from available records as nearly as possible similar to that played by the band or sung by the glee club at the fair.

Representative Newton of Minnesota has reintroduced a bill, which he introduced in Congress last March, to repeal Section 15-A of the Transportation Act and to direct the Interstate Commerce Commission to adjust rates so as to give the carriers an opportunity to earn sufficient income as the basis of such credit as, in the judgment of the commission, may be necessary to meet the transportation needs of the country.

Commissioner Hall of the Interstate Commerce Commission testified at a hearing on January 9 before the Senate committee on interstate commerce that modification of the provisions of the transportation act relating to railway consolidation is imperative if anything is to be done with it, except to the limited extent to which the law now authorizes acquisitions of control short of actual consolidation.

The Canadian National will provide for the payment of pensioned employees of the Central Vermont for the period of a year, at the end of which time it is expected that the reorganization will have been effected. The receivers found that they could not legally continue to make the pension payments and this action on the part of the Canadian National has removed the doubts that existed as to the position of those on the pension list.

Revenue freight car loading for the week ending January 14 totaled 906,734, a decrease of 35,997 cars as compared with the corresponding week in 1927 and of 25,001 as compared with 1926, but an increase of 152,672 cars over the previous week of the present year, which included the New Year's holiday. The total revenue freight car loadings for the year 1927 amounted to 51,714,320 as compared with 53,098,819 and 51,224,152 in 1926 and 1925, respectively.

Representative Murphy, of Ohio, has introduced in Congress a bill, H. R. 7901, which would nullify, conditionally, the rule requiring anyone about to cross a railway track to stop, look and listen, as recently interpreted by the Supreme court of the United States. The bill provides that in suits arising from accidents to highway vehicles at grade crossings of railways no rule shall be adopted by the federal court contrary to the law of the state, territory or place where such accident occurred.

The Graduate School of Business Advancement of Harvard College announces that a special session for business executives will be conducted from July 9 to August 18, and that the course on railway transportation will be in charge of Professor W. J. Cunningham of Harvard and Professor Winthrop M. Daniels of Yale. This course is intended for junior officers and operating and department heads of railroads and will cover both economics and administration. The total tuition will be $200 and the right is reserved to withdraw any course in case 20 applicants have not been enrolled by June 1.

The St. Louis-San Francisco has appointed a florist to direct an extensive program for the improvement of station grounds and other properties. A plan of furnishing section foremen and agents with flower seeds and bulbs for planting gardens on the railroad's property was begun on a small scale in 1927, under the supervision of Dan B. Fellows, chief clerk in the storekeeper's office at Springfield, Mo., who looked after this work in addition to his other duties. The plan was so successful that Mr. Fellows will now devote all of his time to the work. The first stations around which flowers will be planted this year will be at Columbus, Miss., Aliceville, Ala., Demopolis and Linden, on the extension from Aberdeen, Miss., to Kimbrough, Ala.

Two noteworthy safety records are cited in the December news letter issued by C. F. Larson, secretary of the Steam Railroad Section of the National Safety Council. In the car shops of the Wabash at Decatur, Ill., 600 men have worked 13 months without a reportable injury and during the last three months not a minute's time has been lost on account of accidents. The Chicago Great Western, for the first 11 months of 1927, had a casualty rate of only 4.3 per million man-hours. This road has never employed a special safety man but places the responsibility on the division superintendents. Daily bulletins are issued by telegraph, giving the number of days since a reportable injury has occurred and copies of the bulletin are given to the train men with their train orders.

Construction News

The Atchison, Topeka & Santa Fe has prepared plans for the construction in 1928 of additional yard facilities at Emporia, Kan. The project will include track scales, stock yards and yard office, together with the construction of 16 tracks which will each have a capacity of 150 cars, the balance of the tracks to accommodate 60 and 90 cars each.

Ponca City, Okla., has voted approval of the issuance of $55,000 of bonds as the city's share of the cost of constructing a highway subway under the tacks of this company at South Avenue.

The Bessemer & Lake Erie has let a contract to the L. A. Wells Construction Company, Cleveland, Ohio, for the removal of a part of the west government pier at Conneaut Harbor, Ohio, and for the rebuilding of part of the pier in Dock No. 1. Cost of the work involved is estimated at $113,000.

The Boston & Albany has awarded a contract to Fairbanks, Morse & Co., Chicago, for the construction of a 1,000-ton coaling plant and a 750-ton sand house at Allston, Mass.

The Boston & Maine has let a contract to the Tredennick Billings Company of Boston, Mass., for changes in the passenger station at Dover, N. H., to accommodate the Portland division office facilities. The Phoenix Bridge Company of Phoenixville, Pa., has been let a contract for the construction of a bridge on the Southern division at Lowell, Mass.

Plans are being considered for improvements at Lawrence, Mass., to include the construction of a new central station, two bridges and the elimination of two grade crossings. The total cost of these improvements is expected to be in the neighborhood of $1,000,000. A contract for the rebuilding of bridges Nos. 26 and 27, at South Lawrence, Mass., has been awarded to the Boston Bridge Works.

A program of reconstruction by the Boston & Maine involving an expenditure aggregating $6,010,000, to make permanent the emergency reconstruction by which railroad service was resumed after the floods and to make other improvements in the course of the year on bridges and roadbed elsewhere on the system, was announced recently by President George Hannauer.

The Canadian National plans the construction of a new express terminal at Toronto, to be a five-story structure of brick and steel, to cost about $300,000.

The Canadian Pacific will apply to the next session of the Canadian Parliament for permission to construct a line from Acme, Alta., on the Langdon-Kneehill branch to a point 25 miles northwest and a line from Rosemary, Alta., on the Bassano-Leader-Swift Current branch to a point 20 miles northwest. At the same time the company will apply for permission to issue securities not exceeding $40,000 per mile in amount to finance this construction.

The Central of Georgia plans the construction of new station facilities at Thomaston, Ga., and the construction of warehouses at Rome, Ga.

The Central Railroad of New Jersey has awarded a contract for the construction of a viaduct at Rockaway, N. J., to the T. F. Foley Construction Company, Pittsburgh, Pa., at an estimated cost of $75,000.

The Chicago, Rock Island & Pacific company has applied to the Interstate Commerce Commission for authority to construct 7.16 miles of new line through Oklahoma City, Okla., in place of a line of 0.77 miles to be abandoned.

The Detroit, Grand Haven & Milwaukee, a subsidiary of the Grand Trunk Western, has applied to the Interstate Commerce Commission for authority to relocate its existing line between Royal Oak township and Bloomfield township, Oakland county, Mich., 8.88 miles, and to abandon its present line 9.1 miles between the same points.

The Detroit, Toledo & Ironton has awarded a contract for grading and the construction of abutments for highway grade crossing elimination structures on a portion of the Malinta (Ohio)-Durban (Mich.) line of this railroad in the vicinity of Delta, Ohio, to A. Guthrie & Co., St. Paul, Minn.

The Edmonton, Dunvegan & British Columbia has applied to the Dominion of Canada for permission to construct extensions from Spirit River, Alta., west 68 miles into British Columbia and from Wembley, Alta., northwest about 120 miles into British Columbia.

The Great Northern plans the construction of an addition to its grain elevator at Superior, Wis., consisting of 240 concrete tanks, each 110 ft. high and 13 ft. in diameter. With the enlargement of the workhouse and the installation of the necessary machinery the project is expected to involve an expenditure of more than $800,000.

This company plans the construction of a branch from either Beaverton, Mont., or Saco, on the main line to Turner, Mont., near the Canadian border, about 80 miles to furnish transportation to 61 townships in a fertile spring wheat territory. The cost of construction of the line is estimated at $2,000,000.

The Kansas City Southern has been granted an extension of time for three years from December 31, 1927, for the completion of two lines in Caddo Parish, La., by this company and the Kansas City, Shreveport & Gulf under the Interstate Commerce Commission's certificate of October 31, 1925.

The Maine Central plans the reconstruction of the Passumpsic River bridge at St. Johnsbury, Vt., at a cost of $50,000. The American Bridge Company has been awarded a contract for the steel work of this bridge at a cost of approximately $20,000.

The Missouri Pacific received bids until January 28 for the construction of a union station at Texarkana, Ark. This project, which will involve an expenditure of about $1,700,000, will include the construction of a two-story main building, a one-story mail annex and accompanying train sheds. Construction will be of brick, stone, steel and reinforced concrete.

Bids will close on February 6 for the construction of about 14 miles of new double-track line to replace the existing single-track line between Boles, Mo., and Allenton. This project involves the driving of two tunnels, 1,600 ft. and 550 ft. long, respectively, and is expected to require a total expenditure of about $4,500,000.

The National of Mexico plans to transfer its tie and timber treating plant now located at Aguascalientes, Agt., to Acambaro, Gto. By the installation of additional machinery it is also planned to increase the capacity of the plant from 98,000 to 260,000 ties per month and equip it for treatment by a variety of methods. Plans have also been prepared for the construction of additional yard tracks and facilities in connection with the construction of a $1,000,000 repair shop and engine terminal at Monterey, N. L. The total cost of this work is estimated at $476,000.

The New York Central is considering plans to enlarge track facilities and to develop yardage lying east and north of the union station at Albany, N. Y.

The Norfolk & Western has given a contract for the elimination of grade crossings at Sutherland, Va., and Poole, Va., to H. M. Waugh, Williamson, W. Va. The work involves the placing of about 2,500 cu. yd. of concrete and the excavation of about 15,000 cu. yd. of earth.

A contract has been let to the Walton Construction Company, Roanoke, Va., for the construction of a yard with 14 miles of tracks, track scale, water facilities and yard offices at Winston-Salem, N. C., to cost about $800,000.

The Pacific Great Eastern has awarded a contract for the construction of a concrete lined tunnel under Lonsdale avenue, extending between St. George's and Rogers avenue, North Vancouver, B. C., a part of the connection between this railroad and the terminal railway of the Vancouver Harbor Board, to the Vancouver Pile Driving and Contracting Company, Vancouver, B. C., at a cost of about $198,000.

The Pennsylvania has awarded a contract to D. S. Warfel, of Lancaster, Pa., for the construction of the express building at the new passenger station at Lancaster, to cost $60,000. A contract has also been let to the Huges-Foulkrod Company of Philadelphia, Pa., for the construction of a passenger bridge, platforms, shelters and baggage

tunnel at the same station at a cost of $225,000.

A contract has been awarded to the Cleveland Engineering Company, Cleveland, Ohio, for dredging the harbor at Ashtabula Harbor, Ohio, at a cost of $30,000.

A contract has been awarded to the James McGraw Company of Philadelphia, Pa., for grading, masonry work and station platforms in connection with the new Market Street subway at Harrisburg, Pa., which it is estimated will cost $300,000. This company has also been let a contract for track work incident to changes required in connection with the construction of the subway at a cost of $100,000.

The St. Louis & Hannibal has awarded a contract to the Roberts & Schaefer Company, Chicago, for a coaling station at Hannibal, Mo.

The St. Louis & O'Fallon has awarded a contract to the Ogle Construction Company, Chicago, for a single track ash and sand plant to be installed at East St. Louis, Ill.

The St. Louis-San Francisco will contribute about $300,000 toward the construction of a viaduct over the tracks of this company at Arsenal Street, St. Louis. The viaduct will be about 1,750 ft. long with a 60 ft. roadway, and will cost $531,000.

A contract has been awarded to the Ogle Construction Company, Chicago, for reinforced concrete 100-ton coaling stations to be erected at Pleasant Ridge, Ala., and Magnolia.

The Terminal Railroad Association of St. Louis, the East St. Louis & Suburban and the City of East St. Louis, Ill., plan the construction of a reinforced concrete viaduct to carry the tracks of the two railroads over State street, near Twenty-first street, at East St. Louis. The project will involve the elevation of the tracks of the T.R.R.A. about 10 ft. above their present level and the depression of State street about 6 ft. The cost, which will be divided between the two railroads and the city, is estimated at $300,000.

The Texas & Pacific plans the construction of a freight station on Pacific avenue near Central and Hawkins streets, Dallas, Tex., to cost about $300,000.

The Union Pacific will close bids on February 6 for the construction of an extension from its present line near Creighton, Wyo., to a point on its main line near Burns, Wyo., about 54 miles.

The Vicksburg Bridge & Terminal Company has been organized for the purpose of constructing a combination railroad and vehicular bridge across the Mississippi river at Vicksburg, Miss. The main structure will have five spans 417 ft. long, one span 178 ft. long, and a channel span 825 ft. long. The cost of the structure has been estimated at $3,000,000. It is understood that negotiations are now under way for the use of the bridge by the Vicksburg, Shreveport & Pacific, a subsidiary of the Illinois Central.

Supply Trade News

General

The National Lumber & Creosoting Company, Texarkana, Ark., has acquired 60 acres of land at Utah Junction, Colo., on which it plans the construction of a timber treating plant.

Engineer and Constructors, Inc., has been formed by a combination of the United Gas Improvement Construction Company, Philadelphia, Pa., Dwight P. Robinson & Co., New York, Day & Zimmerman Engineering & Construction Company, Philadelphia, and the Public Service Production Company, Newark, N. J. The headquarters of the new company will be in Philadelphia, with offices in New York, Newark, Chicago, Los Angeles, Cal.; Atlanta, Ga.; Houston, Tex.; Pittsburgh, Pa.; Montreal, Que.; Buenos Aires, Argentine, and Rio de Janeiro, Brazil. **Dwight P. Robinson** is president of the new company.

The Timken Roller Bearing Company, Canton, Ohio, has authoized the expenditure of $4,000,000 in 1928 for increasing its production facilities, the greater part of which will be applied to the enlargement of the plant at Canton.

The American Carbolite Company, which has taken over the sales of the entire output of the Carbic Manufacturing Company, has appointed the Oxweld Acetylene Company its exclusive agent for the sale of Carbic lighting, welding and cutting equipment and the Union Carbide Sales Company its exclusive agent for the sale of Carbic cakes.

Personal

John A. MacLean, Jr., has been appointed representative of the MacLean-Fogg Lock Nut Company, Chicago.

F. Baackes, vice-president and general sales agent of the American Steel & Wire Company, Chicago, has been elected senior vice-president and **D. A. Merriman**, assistant general sales agent, has been promoted to general manager of sales. **L. J. Gray**, assistant superintendent of mills, has been promoted to assistant to the president.

J. H. Waterman, formerly superintendent of timber preservation of the Chicago, Burlington & Quincy, has been appointed a special agent for the Curtin-Howe Corporation, New York. A sketch of Mr. Waterman's career was published on page 388 of the September (1927) issue of *Railway Engineering and Maintenance*.

P. C. Brooks, president of E. T. Fairbanks & Co., the scale manufacturing subsidiary of Fairbanks, Morse & Co., and vice-president of the Canadian Fairbanks, Morse Company, Ltd., has been elected also vice-president of Fairbanks, Morse & Co. Mr. Brooks graduated from the Georgia Institute of Technology in 1891, following which he was connected with a number of manufacturing concerns. He became associated with Fairbanks, Morse & Co. in 1899, as assistant manager of the Beloit works and later was promoted to acting manager. After serving the company in various capacities

P. C. Brooks

he was elected vice-president of the Canadian Fairbanks, Morse Company in 1916, and in the following year was elected also president of E. T. Fairbanks & Co.

William Schwanhausser, chief engineer of the Worthington Pump & Machinery Corporation, died on January 15 at the Peck Memorial Hospital, Brooklyn, N. Y., after an illness of six months at the age of 73. Mr. Schwanhausser was born in Wurzburg, Bavaria, and graduated from the Polytechnic Institute in Mittweida, Saxony,

William Schwanhausser

in 1874. After coming to this country he entered the employ of Osterheld & Eichmeyer, Yonkers, N. Y., in the development of engines, pumps and various mechanical devices. Later, he became assistant superintendent of the Otis Elevator Company, spending eight years on the improvement of the hydraulic elevator. Mr. Schwanhausser became connected with Henry R. Worthington in 1885 and was placed in charge of the manufacture of pumps in the works at Brooklyn. He was

placed at the head of the Worthington interests in Germany in 1895 and in the following year became chief and consulting engineer of the International Steam Pump Company, a combination including Worthington and other pump manufacturers in the United States, which later became the Worthington Pump & Machinery Corporation. Mr. Schwanhausser retained his title of chief engineer with the new corporation and was holding that position at the time of his death.

Herbert G. Thompson, president of the Anchor Fence Post Company, with headquarters at New York, died on January 11 while leaving the Grand Central Terminal after returning from a business trip.

Trade Publications

Creosote Treatment of Douglas Fir Ties.—An eight-page booklet issued by the Pacific Creosoting Company, Seattle, Wash., describes in detail the methods employed and the results obtained in tests to show the effects of creosote treatment on the crushing strength of Douglas fir ties.

Sullivan Rotator Rock Drills.—Bulletin No. 81-Q, issued by the Sullivan Machinery Company, Chicago, describes two new hand-held hammer rock drills which are made in two models: L-5 medium, weighing 75 lbs., and L-3 heavy, weighing 97 lbs. The bulletin is illustrated with views of parts of the machine and also of their performance in actual work. Full details as to dimensions and weights are also given.

Convertible Cranes.—A four-page circular issued by the Northwest Engineering Company, Chicago, describes the cranes built by that company for various kinds of railway maintenance work, which cranes can be converted into power shovels or drag lines. These cranes are made in four sizes, ranging from a ½-yd. crane with a 30-ft. boom, a ½-yd. shovel, or a ½-yd. dragline with a 35-ft. boom, to a 1-yd. crane with a 45-ft. boom, a 1¼-yd. shovel, or a 1-yd. dragline with a 45-ft. boom. The cranes are mounted on crawler treads and may be furnished with gasoline, Diesel engine or electric power.

Horton Steel Tanks.—Standard steel structures for the storage of liquids on railways are described in a 20-page booklet issued by the Chicago Bridge & Iron Company, Chicago. Specific reference is made to conical-bottom and ellipsoidal-bottom tanks—two standard designs commonly used for roadside delivery service and in conjunction with water softening plants. Supplementing this, information is given relative to sludge removal from these tanks, as well as the proper type of non-freezing spouts and special heating arrangements available for use in cold climates. In addition, the booklet contains tables covering the installation of elevated and flat-bottom tanks, and a diagram for calculating pipe sizes, discharge, velocities, and loss of head.

Personal Mention

General

L. H. Harper, who resigned in 1927 as superintendent of the creosoting plant of the Central of Georgia, has again been appointed to that position, with headquarters at Macon, Ga.

H. L. Bell, division engineer of the Beaumont division of the Southern Pacific lines in Texas, with headquarters at Houston, Tex., has been promoted to assistant superintendent of the same division, with headquarters at

H. L. Bell

the same point. Mr. Bell was born at Edmond, Okla., on July 21, 1894, and was educated at Rice Institute, where he graduated in 1919. He entered railway service in November of the same year in the valuation department of the Southern Pacific, and in June, 1920, was promoted to assistant engineer. In the following December he was promoted to roadmaster of the Lufkin district of the Shreveport division, with headquarters at Lufkin, Tex., and was further promoted to division engineer in April, 1924, which position he was holding at the time of his recent promotion to assistant superintendent.

A. L. Hawley, assistant general auditor of the Southern Pacific, with headquarters at San Francisco, Cal., whose early railway experience was in the engineering department, has retired from active duty under the pension rules of that company after more than 41 years of railway service. Mr. Hawley was born on October 15, 1859, and graduated from Cornell University in 1886, entering railway service in the latter year as an assistant engineer on the Ft. Worth & Denver City and associated roads (now part of the Colorado & Southern lines). From 1890 to 1892 he was assistant engineer and division engineer on the Union Pacific, and was engaged for several months in 1892 as assistant engineer on location surveys in the Rocky Mountains. After service as a draftsman in the office of the United States surveyor general for Colorado, Mr. Hawley became a clerk in the auditing department of the Union Pacific in May, 1894, and in 1902 was appointed auditor of the El Paso & Southwestern. He was promoted to general auditor in 1907, and when the El Paso & Southwestern was acquired by the Southern Pacific he was appointed assistant general auditor of the latter road, which position he was holding at the time of his recent retirement.

G. L. R. French, assistant vice-president and general manager of the Rutland, with headquarters at Rutland, Vt., whose early training was in the engineering and roadway departments, has been promoted to vice-president and general manager, with headquarters at the same point. Mr. French was born on May 18, 1863, at Salisbury, Mass., and graduated from the Massachusetts Institute of Technology in 1884. He entered railway service in September of the same year with the Burlington & Missouri River in Nebraska (now part of the Chicago, Burlington & Quincy) at Lincoln, Neb., where he held various positions in the engineering and operating departments until 1890, when he was appointed roadmaster of the Southern and Eastern divisions of the Boston & Maine. He was later assistant superintendent of the Connecticut River division and superintendent of the Boston Terminal division of the same road until May 1, 1912, when he was appointed general superintendent of the Rutland, with headquarters at Rutland, Vt. In January, 1923, he was promoted to acting general manager and in November, 1924, was made general manager. Mr. French was promoted to assistant vice-president and general manager in October, 1926, which position he was holding at the time of his recent promotion to vice-president and general manager.

Engineering

Elbert H. Dresser, formerly assistant engineer on the Duluth, Missabe & Northern, has been appointed chief engineer, with headquarters at Duluth, Minn., to succeed **W. H. Hoyt**, deceased.

John T. Ridgely, division engineer of the Richmond division of the Pennsylvania, with headquarters at Richmond, Ind., has been appointed engineer maintenance of way of the Long Island with headquarters at Jamaica, N. Y., succeeding **G. P. Williams**, transferred.

F. H. Hibbard, engineer maintenance of way of the Quebec Central, with headquarters at Sherbrooke, Que., has been promoted to engineer, with the same headquarters, taking over the duties heretofore performed by **J. T. Morkill**, chief engineer, and **J. Farquhar**, superintendent of bridges and buildings, who have retired under the superannuation regulations.

P. G. Burns, formerly chief engineer of the Trinity & Brazos Valley, has been appointed chief engineer in charge of construction and maintenance of the Waco, Beaumont, Trinity & Sabine,

with headquarters at Houston, Tex. **Horace Beyett** has been appointed assistant to the chief engineer, with headquarters at Trinity, Tex.

J. R. Nagel, division engineer of the Missouri division of the Missouri Pacific, with headquarters at Poplar Bluff, Mo., has been given jurisdiction also over the Illinois division.

William Atlee James, assistant chief engineer of the Western lines of the Canadian Pacific, with headquarters at Winnipeg, Man., retired from active service on December 31 after a service of almost 30 years with that road. Mr. James was born on June 4, 1864, at

William Atlee James

Ebensburg, Pa., and entered railway service in September, 1883, as a flagman on the Burlington & Missouri River in Nebraska (now a part of the Chicago, Burlington & Quincy), with which road he served in various capacities from flagman to division engineer until 1897 with the exception of short periods in 1891 and 1894 when he was a transitman on the Great Northern and transitman and resident engineer on the Butte, Anaconda & Pacific, respectively. In June, 1898, he became an assistant engineer on the Canadian Pacific and later was promoted to locating engineer. He was promoted to division engineer of construction at Winnipeg in 1909 and in 1912 was made engineer of construction of the Western lines, with headquarters at the same place. Mr. James was promoted to assistant chief engineer of the Western lines in 1918, which position he was holding at the time of his retirement.

W. A. Johns, division engineer of the St. Louis division of the Pennsylvania, with headquarters at Terre Haute, Ind., has been promoted to engineer maintenance of way of the Western region, with headquarters at Chicago, a newly created position, and **C. E. Adams,** supervisor on the Eastern division, with headquarters at Rochester, Pa., has been promoted to division engineer to succeed Mr. Johns. **J. C. White,** supervisor at Tyrone, Pa., has been promoted to division engineer of the Richmond division, with headquarters at Richmond, Ind., to succeed **J. T. Ridgely,** whose appointment as engineer maintenance of way of the Long Island is noted elsewhere in this issue. **T. H. Miller,** assistant on engineer corps, has been promoted to assistant to the division engineer of the St. Louis division, with headquarters at Terre Haute, Ind.

Alan T. Danver, acting supervisor of bridges and buildings on the Rutland during reconstruction following the November flood, has been promoted to principal assistant engineer, with headquarters at Rutland, Vt., suceeeding **F. R. Stevens,** who has been promoted to office engineer and valuation engineer. Mr. Danver was born on June 21, 1893, at Stamford, Conn., and graduated from Tufts College Engineering School in 1915, entering railway service in July of the same year as assistant bridge inspector on the Boston & Maine. Four months later he became a draftsman on the Boston & Albany at Boston, Mass., and in 1919 he was promoted to structural designer. He was appointed assistant engineer in May, 1924, and was resident engineer on the B. & A. work in connection with the Castleton cut-off at Niverville, N. Y. Mr. Danver became an engineering assistant on the Rutland in June, 1925, and in November, 1927, was promoted to acting supervisor of bridges and buildings, which position he was holding at the time of his promotion to principal assistant engineer.

Einar Weidemann, assistant engineer of bridges of the Pennsylvania, with headquarters at Chicago, Ill., has been promoted to engineer of bridges and buildings of the Western region, with headquarters at the same point. Mr. Weidemann was born on May 29, 1877,

Einar Weidemann

at Trondhjem, Norway, and graduated from the Technical Institute in that city in 1897, after which he was engaged for several years in railroad construction for the Norwegian government. He came to the United States in 1903, and became a draftsman for the American Bridge Company at Pittsburgh, Pa. In the following year he became an assistant to Herman Laub (now deceased), consulting engineer and bridge specialist on the Pennsylvania in the same city. On May 1, 1915, Mr. Weidemann became a structural engineer for the Chicago Union Station Company, and was promoted to engineer of buildings and structures on that project on January 1, 1923. On the completion of the construction of the station he returned to the Pennsylvania as an assistant engineer at Chicago and was promoted to assistant engineer of bridges, with headquarters at the same point, which position he was holding at the time of his recent promotion to engineer of bridges and buildings of the Western region.

Russell L. Huntley, whose retirement on December 31 as chief engineer of the Union Pacific system, was noted in the January issue, was born in New

Russell L. Huntley

York and graduated from the Renssalaer Polytechnic Institute in 1880. He entered railway service in the same year as an engineer on construction for the New York Central & Hudson River (now a part of the New York Central) and later was division engineer on maintenance and construction. On July 1, 1886, he became a locating engineer on the St. Joseph & Grand Island (now a part of the Union Pacific system), remaining with that road until August 1, 1888, when he became an assistant engineer in charge of shop construction on the Union Pacific. From January, 1890, to June, 1899, Mr. Huntley was engaged in bridge construction and in the location and construction of new lines, following which he was promoted to principal assistant engineer. He was further promoted to acting chief engineer of the Union Pacific Railroad on February 1, 1905, and in September of the following year he was made chief engineer. He was promoted to chief engineer of the system in August, 1918, and occupied that position continuously until the time of his retirement.

G. J. Adamson, division engineer on the Union Pacific, with headquarters at Green River, Wyo., whose promotion to assistant chief engineer of the system was noted in the January issue, was born on May 9, 1880, at Iowa Falls, Iowa, and graduated from Iowa State College in 1905. He entered railway

service in the same year as a draftsman on the St. Paul & Des Moines (now a part of the Chicago, Rock Island & Pacific) and in February, 1906, became a clerk in the office of the chief engineer of the Union Pacific. In the early part of 1907 he was in the service of the Kansas City Southern, returning to the Union Pacific on March 12, 1907, as a draftsman in the office of the chief engineer on various construction projects. Mr. Adamson was promoted to division engineer of the Wyoming division, with headquarters at Cheyenne, Wyo., on November 15, 1915, and two years later was transferred to the Western division, with headquarters at Green River, where he was located at the time of his recent promotion to assistant chief engineer of the system.

Moses Burpee, whose retirement as chief engineer and appointment as consulting engineer of the Bangor & Aroostook was noted in the January issue, was born in 1847 at Sheffield, N. B. He entered railway service in 1869 as a rodman on the European & North American (now the Atlantic division of the Canadian Pacific), later serving as junior assistant and station agent. From 1871 to 1877 he was employed on the Prince Edward Island (now a part of the Canadian National) and the New Brunswick (now a part of the Canadian Pacific). He entered the service of the Chicago, Milwaukee & St. Paul in April, 1879, and later served as assistant engineer and engineer in charge of surveys until 1883, when he entered the employ of the Canadian Pacific on the

Moses Burpee

construction of the Western division. During 1884 he was in charge of surveys for the Central of New Brunswick (now part of the New Brunswick Coal & Railway Company) and the Short Line Railway of Maine, and in 1885 was appointed chief engineer in charge of maintenance of the New Brunswick. Mr. Burpee was appointed chief engineer of the Bangor & Aroostook in 1891, which position he was holding at the time of his retirement.

G. A. Boyer, roadmaster on the Beaumont division of the Southern Pacific lines in Texas, with headquarters at Houston, Tex., has been promoted to division engineer of the same division, with headquarters at the same point, to succeed **H. L. Bell,** whose promotion to assistant superintendent is noted elsewhere in this issue.

A. F. Stotler, district engineer of the Northern Pacific, west of Ellensburg, Wash., with headquarters at Seattle, Wash., has been promoted to assistant chief engineer and engineer maintenance of way of the lines west of Paradise, Mont., with headquarters at the

A. F. Stotler

same point, to succeed **A. R. Cook,** who retired on December 31 under the pension rules of the company. **H. M. Tremaine,** assistant engineer of construction, has been promoted to district engineer of the lines below Ellensburg and Paradise, with headquarters at Spokane, Wash., to replace **G. I. Hayward,** who has been transferred to Seattle to succeed Mr. Stotler.

Mr. Stotler was born on February 22, 1876, at Seattle, Wash., and was educated at Paulson Academy and Puget Sound College. He entered railway service in the fall of 1897 as a chainman on the Northern Pacific, with which company he has been connected since that time except for four months when he was engaged in private business, and a short period in 1909 when he was district engineer with the Oregon-Washington Railroad and Navigation Company at Portland, Ore. He was promoted to resident engineer on maintenance in 1901 and also served on the enlargement of the Portland terminals and as an assistant engineer on location and second track construction near Glendive, Mont. In April, 1911, he was promoted to supervisor of bridges and buildings and roadmaster of the Tacoma terminals, and in May, 1912, was appointed assistant roadmaster in charge of reballasting. In 1913 Mr. Stotler was appointed supervisor of bridges and buildings on the Puget Sound division, being located at Seattle, and later at Tacoma. In 1917 he was promoted to district engineer of the lines west of Ellensburg, with headquarters at Seattle, which position he was holding at the time of his recent promotion to assistant chief engineer and engineer maintenance of way of the lines west of Paradise.

Mr. Cook was born on December 7, 1857, at Lenox, N. Y., and was educated at the Episcopal Military Academy, Cheshire, Conn. His early railway experience was gained during school vacations in 1872, 1880, 1881 and 1882, as chainman, rodman and instrumentman on the Norwich & Worcester and the Providence & Worcester (now parts of the New York, New Haven & Hartford). In 1885 he became an assistant engineer on the Chicago, Burlington & Northern (now a part of the Chicago, Burlington & Quincy) and in 1887 entered the service of the Minneapolis, St. Paul and Sault Ste. Marie in a similar capacity. Later he was successively assistant engineer on the St. Paul, Minneapolis and Manitoba (now a part of the Great Northern), the St. Paul & Northern Pacific (now a part of the Northern Pacific), the Great Northern, the Pacific Coast and the Northern Pacific. He was promoted to engineer maintenance of way of the latter road, with headquarters at Tacoma, Wash., in 1908, and in 1911 was further promoted to principal assistant engineer at the same point. In February, 1923, Mr. Cook was promoted to assistant chief engineer and engineer maintenance of way of the lines west of Paradise, Mont., which position he was holding at the time of his retirement.

L. H. Robinson, whose promotion to assistant engineer maintenance, of way of the Atlantic region of the Canadian National, with headquarters at Moncton, N. B., was noted in the January issue, was born on September 4, 1878, at Brockville, Ont., and graduated from Toronto University in 1904. Mr. Robinson entered railway service during vacations while attending the university as an assistant on Dominion and Provincial surveys and on the construction of the Temiskaming & Northern Ontario. In 1904 he became an assistant engineer on location surveys for the National Transcontinental (now a part of the Canadian National) and in 1908 became a resident engineer on the construction of this railway, serving in this capacity until 1911, when he was placed in charge of the construction of division terminals. He became a location engineer on the Canadian Pacific in 1913 and in 1914 returned to the Canadian National in the same capacity. In 1919 he was promoted to division engineer of the Bridgewater division, with headquarters at Bridgewater, N. S., and in 1923 was transferred to the Campbellton division, with headquarters at Campbellton, N. B. He was transferred to the Halifax division, with headquarters at Halifax, N. S., late in 1926, at which point he was located at the time of his recent promotion to assistant engineer maintenance of way of the Atlantic region.

P. C. Newbegin, whose promotion to chief engineer of the Bangor & Aroostook, with headquarters at Houlton, Me., was noted in the January issue, was born on May 19, 1869, at Defiance, Ohio, and graduated from the Massa-

chusetts Institute of Technology in 1891. He entered railway service on June 15, 1894, as a rodman on the Bangor & Aroostook, and from June, 1896, to January, 1901, he was superintendent and assistant engineer on the Patten & Sherman (now a part of the Bangor & Aroostook). He returned to the Bangor & Aroostook in July, 1901, as an assistant engineer and was promoted to engineer maintenance of way in 1907, which position he was holding at the time of his recent promotion to chief engineer.

Changes on the Seaboard Air Line

Coincident with the abolition of the positions of district engineer maintenance of way on the Seaboard Air Line, **Vance Sykes,** district engineer maintenance of way, with headquarters at Hamlet, N. C., has been appointed division engineer of the North Carolina division, with headquarters at the same place, succeeding **R. L. Tatum,** transferred to the Virginia division, with headquarters at Raleigh, N. C., to replaced **C. A. McRee,** who has been transferred to the East Florida division with headquarters at Indiantown, Fla., succeeding **D. T. Daily,** transferred. **A. O. Wilson,** district engineer maintenance of way, with headquarters at Savannah, has been appointed division engineer of the Alabama division, with headquarters at the same point, to take the place of **E. L. Cannon,** transferred, and **O. F. McNairy,** district engineer maintenance of way, with headquarters at Jacksonville, Fla., has been appointed division engineer of the South Carolina division, with headquarters at the same place, succeeding **E. D. Hall,** transferred.

Track

John H. Hayes, roadmaster on the Northern Pacific, with headquarters at Moscow, Idaho, has been appointed roadmaster on the Camas Prairie, with headquarters at Lewiston, Idaho, and the position of roadmaster at Moscow has been abolished.

V. C. Hanna, supervisor of bridges and buildings on the Montgomery district of the Mobile & Ohio, with headquarters at Tuscaloosa, Ala., has been promoted to assistant roadmaster on the St. Louis division, with headquarters at Murphysboro, Ill., succeeding **S. W. Cheatham,** who has been transferred to Tuscaloosa to succeed Mr. Hanna.

Paul I. Buser, yard foreman on the Chicago, Rock Island & Pacific, at Cedar Rapids, Iowa, has been promoted to roadmaster on branch lines near Iowa City, Iowa, with headquarters in that city, to replace **J. R. Hayes,** who has been transferred to Cedar Rapids to succeed **C. Linehan,** notice of whose death will be found elsewhere in this issue.

J. R. McLean, instrumentman on the Canadian National at Saskatoon, Sask., has been promoted to roadmaster, with jurisdiction over the Langham and Carlton subdivisions between North Saskatoon and Warman, and the Saskatoon terminal subdivision, with headquarters at Saskatoon, succeeding **G. Eyford,** who has been transferred to the Manitoba district.

C. G. Grove, supervisor on the Buffalo division of the Pennsylvania, with headquarters at East Aurora, N. Y., has been transferred to the Eastern division, with headquarters at Wooster, Ohio, to succeed **F. H. Bentley,** who has been transferred to the Allegheny division at DuBois, Pa., where he replaces **R. D. Burns,** transferred to the Buffalo division at East Aurora, N. Y., to succeed Mr. Grove.

Bridge and Building

S. W. Cheatham, assistant roadmaster on the St. Louis division of the Mobile & Ohio, with headquarters at Murphsboro, Ill., has been appointed supervisor of bridges and buildings on the Montgomery division, with headquarters at Tuscaloosa, Ala., to succeed V. C. Hanna, who has been appointed assistant roadmaster at Murphysboro.

Duncan Smith, whose promotion to bridge and building master on the Canadian Pacific, with headquarters at Saskatoon, Sask., was noted in the December issue, was born on April 6, 1881, at Aberdeenshire, Scotland. Mr. Smith entered railway service on June 6, 1896, as a water boy on the Canadian Pacific, serving in this capacity and as an extra gang laborer until 1899, when he became a bridge and building laborer on the Algoma district, where he remained until July, 1904, being advanced successively to bridgeman, carpenter and foreman. From July, 1904, to December, 1905, he was a bridge and building carpenter on the Manitoba district, when he was promoted to foreman. Mr. Smith served overseas with the Canadian forces from December, 1914, until April, 1919, resuming his duties as a bridge and building foreman on the Manitoba district on the latter date. He was promoted to bridge and building master on the Lethbridge division in July, 1923, and in 1926 was appointed construction superintendent of the Bonheur rock crushing plant, which position he was holding at the time of his recent promotion to bridge and building master.

Purchasing and Stores

W. M. Portlock, general storekeeper of the Seaboard Air Line with headquarters at Portsmouth, Va., has been promoted to purchasing agent. **T. A. Hodges,** assistant general storekeeper, with headquarters at Jacksonville, Fla., has been promoted to general storekeeper, with headquarters at Portsmouth, and the position of assistant general storekeeper has been abolished. **F. B. Lewis** has been appointed storekeeper at Wildwood, Fla., to replace **E. H. Austin,** transferred to Tampa, Fla., where he succeeds **L. H. Haynes,** who has been transferred to Savannah, Ga., succeeding **A. E. Reid,** transferred to Jacksonville, Fla.

Obituary

James Hartley, formerly supervisor of bridges and buildings on the Northern Pacific at Staples, Minn., and Dilworth, who retired two years ago, died at his home at Staples on Christmas day.

C. Linehan, roadmaster on the Chicago, Rock Island & Pacific, with jurisdiction over the line between Burlington, Iowa, and Cedar Rapids, with headquarters at the latter point, died on December 24.

William Franklin Hinkle, retired roadmaster on the St. Louis-San Francisco, died at his home at Wichita, Kan., on December 7 at the age of 59 years after a service of 34 years with that company.

George W. Snyder, 2nd, assistant chief engineer in charge of maintenance of the Pennsylvania, with headquarters at Philadelphia, died at his home in Overbrook, Philadelphia, on January 1 from pneumonia. Mr. Snyder was born on January 9, 1866, at Pottsville, Pa., and was educated at Lehigh University, entering railway service on November 1, 1884, as a rodman on the Renovo division of the Pennsylvania. He was promoted to assistant supervisor on the same

George W. Snyder, 2nd

division on January 1, 1886, and was further promoted to supervisor on August 1, 1890, subsequently serving in the same capacity on the Baltimore division and at Altoona yard. On January 1, 1901, Mr. Snyder was promoted to division engineer of the Monongahela division, being transferred to the Pittsburgh division on June 1, 1903, where he remained until April 1, 1907, when he was promoted to principal assistant engineer of the Western Pennsylvania division, with headquarters at Pittsburgh. On October 25, 1917, he was advanced to assistant engineer maintenance of way of the Eastern lines, and on March 1, 1919, he was made general storekeeper of the Eastern region, this being followed in February, 1924, by his appointment as assistant to the stores manager. In January, 1926, he was appointed assistant chief engineer in charge of maintenance.

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Where the preservation of metal surfaces is the main object, first consideration should be given to a pigment that aids in preserving the original elasticity or "life" of the oil.

The pigment *must* be inert—that is, it shall not undergo any chemical change in use because such a change must cause the film to become pervious and lose its protective power.

Dixon's Silica-Graphite Paints are composed of boiled linseed oil for the vehicle and natural flake graphite for the pigment with the addition of small amounts of colors for tinting. They meet the above specifications in every respect.

The thickness of paint films is limited. Beyond a certain thickness the paint runs, or in drying forms a tough skin on the outer side leaving the inner portion soft. By preventing the access of air to the under parts this outer skin retards and even prevents thorough drying.

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Flake graphite has proved, by far, to be the best pigment for metal protective paint. It is the only one of the carbon family that has the marked endurance necessary for a protective paint pigment.

It is absolutely inert and is not affected by the action of acids, alkalies or other deteriorating agents. It has the peculiar quality of "water repellancy" and as corrosion does not occur except in the presence of water or dampness, this is a strong point for its use as a pigment.

Silica is used to give the natural flake graphite still further endurance. Experience has shown that a mechanical mixture of silica and graphite is in no way equal to the natural combination as found in Dixon's Silica-Graphite Paints.

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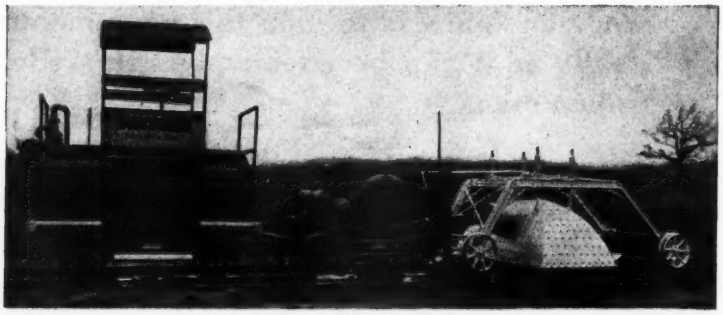

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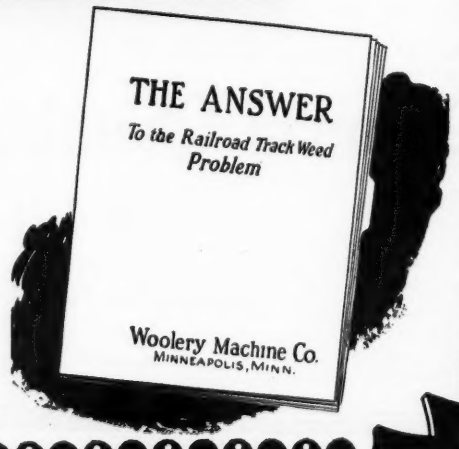

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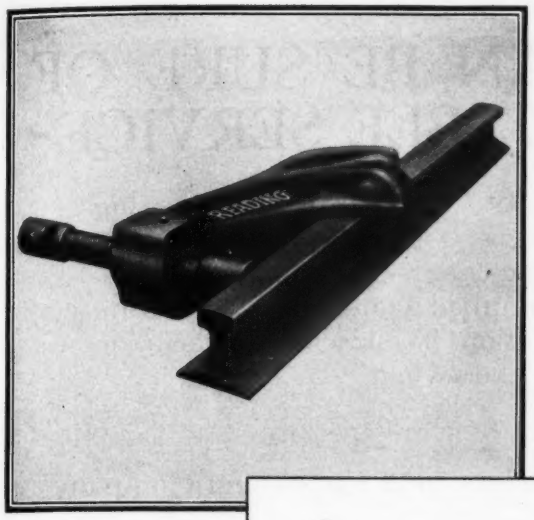
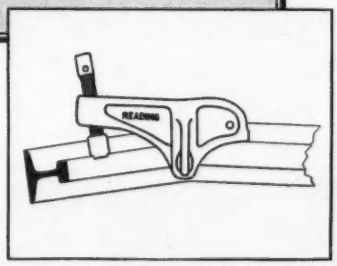




"The screw swivels as the rail bends"

In the illustration above, note how the bearing cap maintains fixed position on the rail.

Allow us to demonstrate this easy operating and efficient rail bender.

READING
"Triple A" Rail Bender

efficient and easy to operate because of a new principle

Reading "Triple A" Rail Benders mount the bending screw in a trunnion bushing which swivels as the rail bends, exerting at all times a pressure that is normal to the point of application on the rail. The result is easier operation, with the unnatural twisting strains on the frame and bending screw eliminated.

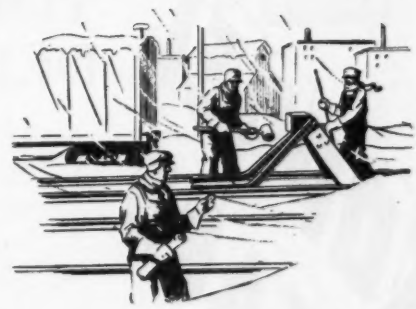
AMERICAN CHAIN COMPANY, INC.
Bridgeport, Connecticut

In Canada: Dominion Chain Company, Limited, Niagara Falls, Ontario.

District Sales Offices: Boston, Chicago, New York, Philadelphia, Pittsburgh, San Francisco.

Other Reading Specialties—

Samson Rail Benders
Reversible Rail Benders
Compromise Joints
Car & Engine Replacers
Replacer Clamps
ACCO One Piece Guard Rails
ACCO Drop Forged Guard Rail Clamps
Resco Cast Steel Guard Rail Clamps



One more particular DURABLE *advantage*

Easy Winter Installation

There isn't an easier bumping post to install than the

Improved* Durable *Bumping Post

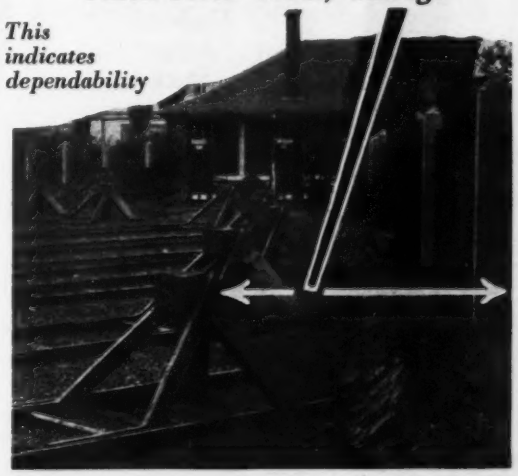
This means something in winter.

With not a spadeful of dirt to turn, holes in only the running rails to drill, all parts of the post fitted and drilled at the Mechanical plant the crew gets the Durable Post in in the shortest possible time, regardless of snow, ice and frozen ground.

As far as serviceability is concerned: you will find long lines of Improved Durables, as in the picture below, in rail yards throughout the country. This is due to the fact that the Improved Durable Bumping Post has demonstrated that it will stop—not retard—even the new extra-heavy freight cars.

MECHANICAL MANUFACTURING COMPANY
Union Stock Yards, Chicago

This indicates dependability



KOPPEL CARS

YOU CAN BE SURE OF DEPENDABLE SERVICE-

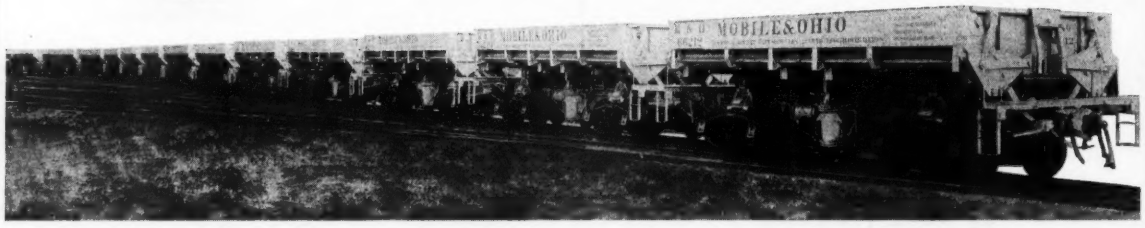
If you specify "Koppel", when ordering Air Dump Cars—Better built—better designed. These cars, today, are used by railroads and railroad contractors with complete satisfaction. You will see them on the big jobs everywhere.

Write for literature

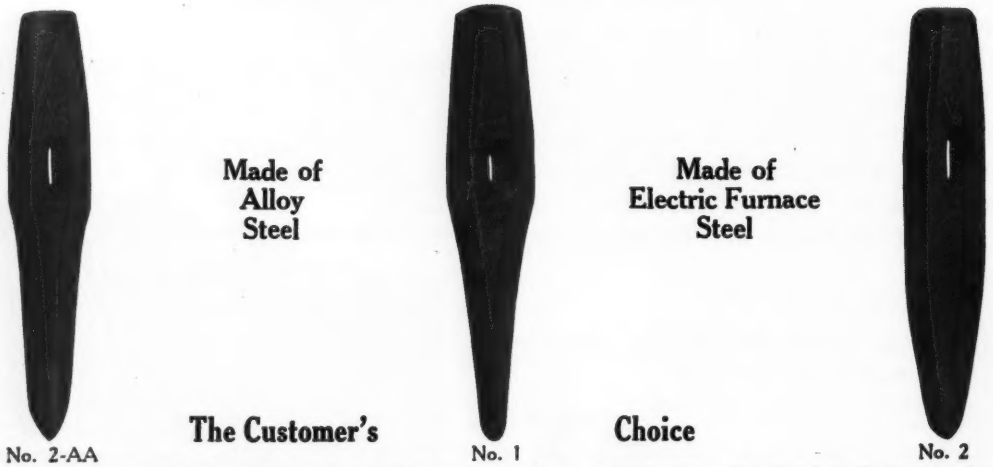
KOPPEL

Koppel Industrial Car & Equipment Company
Koppel Penna.

Sales Offices
PITTSBURGH CHICAGO NEW YORK SAN FRANCISCO



Woodings Latest Entry in the Track Tool Field
Woodings No. 1 Track Chisel



Made of Alloy Steel

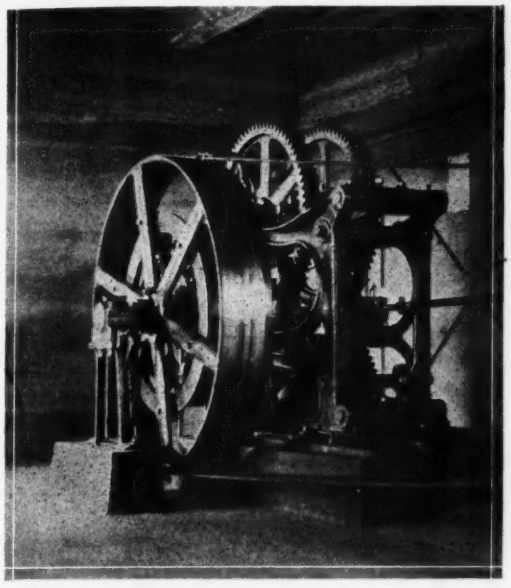
Made of Electric Furnace Steel

No. 2-AA — **The Customer's Choice** — No. 1 — No. 2

All three of these chisels can be made of alloy or electric furnace steel. We offer the three designs so that Roads may choose the design and quality of steel to be furnished. Test for your own satisfaction.

Woodings Forge and Tool Company

Works and General Office VERONA, PA.



Belt driven Pomona supplying water to the Santa Fe at Cutter, New Mexico.

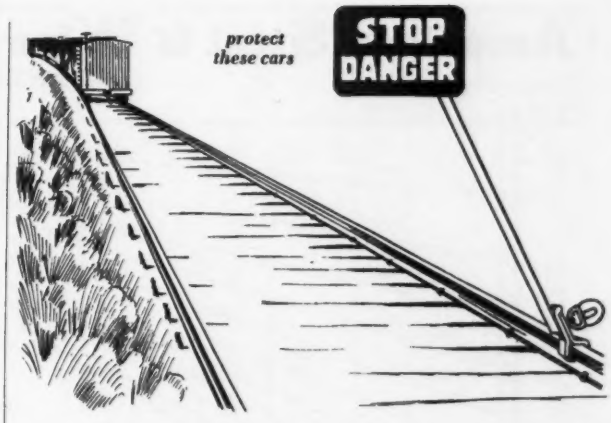
THE
SANTA FE
Finds the
"POMONA"
DEEP WELL DOUBLE STROKE POWER PUMP
VERY ECONOMICAL— and EFFICIENT!

THE over-lapping stroke of the Pomona, its slow speed and reciprocating action — its ruggedness and simplicity of design—all combine to insure maximum uninterrupted service year after year at a remarkably low operating and maintenance cost. This, plus its unusually high efficiency, has influenced the purchase of Pomona pumps by many large railroads—the Santa Fe being only one.

Why not let us tell you what the Pomona will do for you? Write today.

ROGERS IRON WORKS CO.
Successors to Rogers Foundry and Manufacturing Company and the Joplin plant of the United Iron Works, Inc.
JOPLIN, MO.

ROGERS JOPLIN



Safety Always—
with L. F. & S.
(PATENTED)
BLUE SAFETY FLAGS

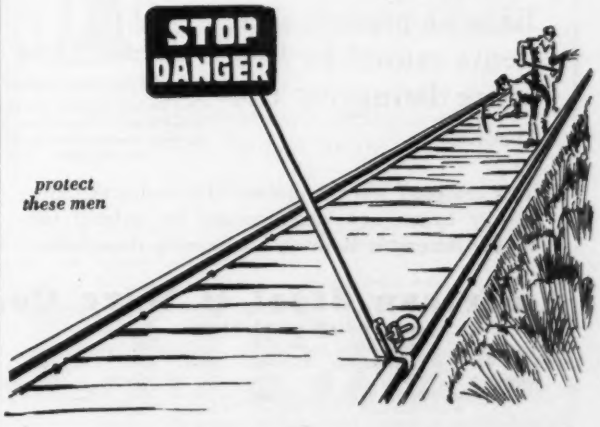
We are all working for a 35% reduction in accidents by 1930

These Blue Safety Flags will help you to accomplish this on your railroad. Do not delay in placing your order for these. Ask for circular.

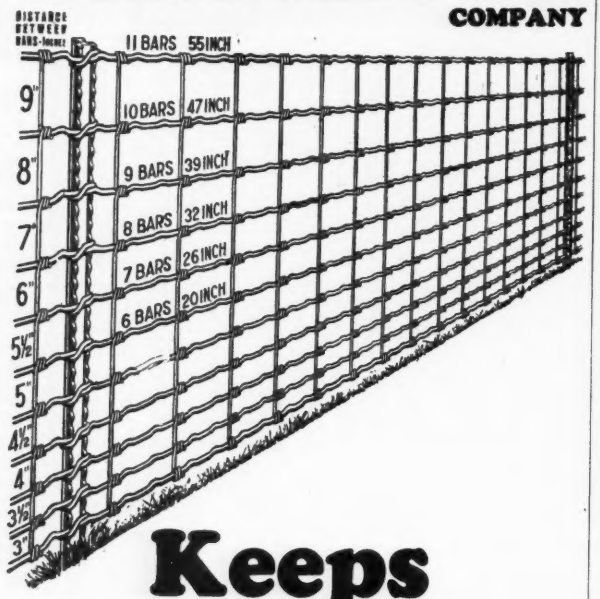
They lock to the rail and cannot be removed except by man having key.

No Accidents Today—
The Cheeriest Report of All

Louisville Frog & Switch Co.
Louisville, Kentucky



American Steel & Wire COMPANY



Keeps Out Stock and Trespassers

Protects You and the Public

Railroads using American Railroad Fence erected on Banner Steel Posts save thousands of dollars yearly in damage claims . . . and likewise prevent accidents caused by live stock being on the tracks.

Steel Posts Save Labor

On a leading railroad one man by test drove 5 Banner Posts in the time it required to set one wooden post

This company was the pioneer in introducing right-of-way fences now recommended for railroad use by the American Railway Engineering Association.

American Steel & Wire Co.

DEALERS EVERYWHERE

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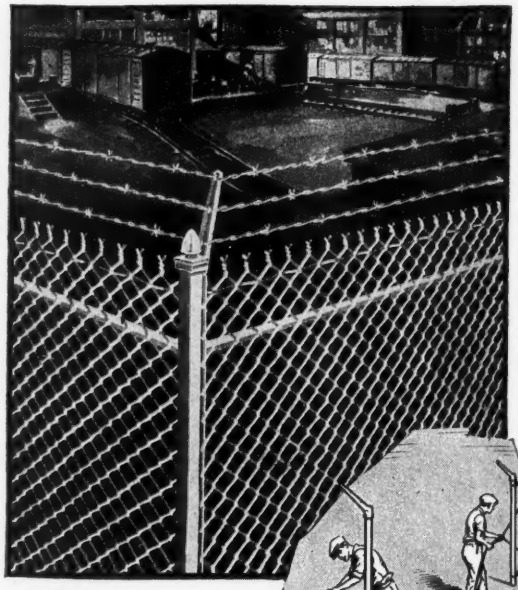
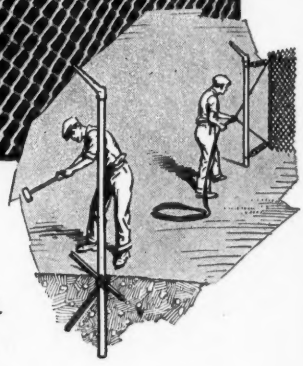
**United States Steel Products Co.*





On-the-dot local fencing service

Prompt, personal attention to your fencing requirements — one of the many important advantages of Anchor Nation-wide Fencing Service!

In 75 principal cities—from coast to coast—Anchor Representatives are located.

If you are in the market for a fence—take advantage of the convenience and economy that this service affords. Learn, too, about the new Anchor Wire-Weld Gate and Square Terminal Posts—both important developments in fence construction.

Anchor Fences are made in types for every railroad service.

For complete information write the nearest office below.

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Main Office and Factory:

Eastern Ave. & 35th St., Baltimore, Md.

Railroad Division

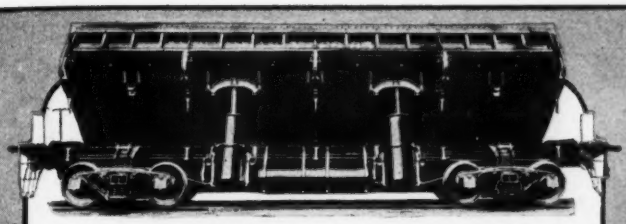
9 East 38th St., New York, N. Y.

Representatives in other Principal Cities

ANCHOR *Fences*

Buy the fence with
1. THE STRONGEST POSTS
2. THE STRONGEST GATES

A NATION-WIDE FENCING SERVICE



MAGOR
AUTOMATIC AIR DUMP CARS

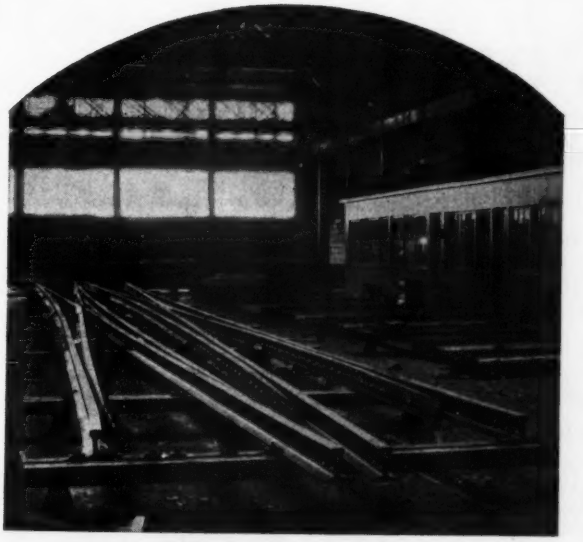
For Quick Work

and big savings of time and labor, this Magor Air Dump Car provides a speedy and economical method of unloading.

It dumps automatically to either side. In full dump position it attains a fifty degree angle assuring a complete discharge of any load clear of the track ballast. Its large capacity accounts for its adaptability and serviceability.

The rugged construction assures dependable and low cost operation. This car is backed by a corporation which has specialized in the design and building of air dump cars for the past twenty years.

MAGOR CAR CORP.
30 Church St. New York



Special switch layout in the Bethlehem plant at Steelton, Pa.

Special Trackwork accurately made

The Bethlehem Frog and Switch Plant is thoroughly equipped to turn out all kinds of special track work in the shortest possible time, and with the highest quality of workmanship.

To insure freedom from trouble when assembling in the field, every layout is completely assembled in well lighted and ventilated shops before shipment. This is all done under cover, and the excellent working conditions are conducive to care and accuracy.

Bethlehem engineers will gladly give you the benefit of their extensive experience without obligation—just write.

Catalog sent on request

BETHLEHEM STEEL COMPANY, *General Offices:* BETHLEHEM, PA.

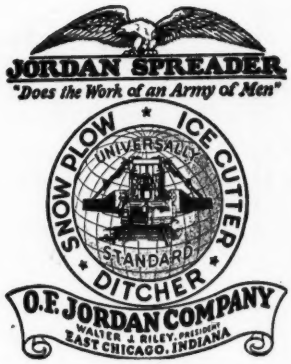
District Offices: New York Boston Philadelphia Baltimore Washington Atlanta Pittsburgh Buffalo Cleveland Detroit Cincinnati Chicago St. Louis San Francisco Los Angeles Seattle Portland

Bethlehem Steel Export Corporation, 25 Broadway, New York City, Sole Exporter of Our Commercial Products

BETHLEHEM

JORDAN SPREADER

THE COMPOSITE SPREADER DITCHER—can be changed in the field either for ditching or for spreading—it performs all the functions of the Spreader (moving earth, spreading bulky material, plowing snow) and in addition will shape the ballast and subgrade, form new ditches and clean out old ones and trim the banks of cuts to a universal slope. An all-year Machine. In use on North America's leading railroads. Write for catalog.



O. F. JORDAN COMPANY

WALTER J. RILEY, President EAST CHICAGO, INDIANA

spring work starts

in the steam railway industry during the early part of March—about the time of the American Railway Engineering Association convention. ¶That's why the March issue of *Railway Engineering and Maintenance* each year is the Annual Labor Saving Number. ¶That's why it focuses the attention of engineering and maintenance officers throughout the railway industry on labor saving materials and equipment. ¶That's why an advertisement in this issue featuring your labor saving equipment will "strike while the iron is hot."

The Labor Saving Number—the March issue will be mailed in time to reach the railway men before they leave for the convention and exhibit*—this gives an added advantage to your advertisement, but it means we must close the forms for the press February 15th.

Wire your reservation for space now and mail copy to

RAILWAY ENGINEERING AND MAINTENANCE

105 W. Adams Street **Chicago, Ill.**

**The A. R. E. A. will hold its annual convention at the Palmer House, Chicago, March 6, 7 and 8. Exhibit by the N. R. A. A. at the Coliseum, Chicago, March 5, 6, 7 and 8.*

690

Saves its cost on the First Job

This American Portable Variety Woodworker lets you do any woodworking operation of either a routine or special nature right on the job. Figure the saving over hand or shop work! Hundreds are now in use.

This one machine may be used as a rip or cut-off saw, as a dado, gaining, grooving, rabbiting, tenoning or boring machine, as a jointer or planer, a matcher, molder or sander and as a hollow chisel mortiser.

Let us send you our Bulletin No. 82 describing our full line of Woodworking Machines for use on the job or in the shop.

– See – Railway Engineering and Maintenance 1926 Cyclopedia Edition for detailed information

American Saw Mill Machinery Co.
164 Main Street, Hackettstown, N. J.
"American" Saw Mills and Woodworkers

Solve the grade crossings replacement problem

HEADLEY NO. 1

THERE is one grade crossing material that will stand the abuse that every grade crossing must stand today and do it at the lowest possible maintenance cost. It is Headley No. 1 especially prepared to give longer wear where the wear is greatest. The outstanding advantages of this material over other methods are too numerous to detail here. Write for further particulars.

Headley Good Roads Company
Franklin Trust Building
Philadelphia Pa.

MORE THAN HALF
of the
RAILROAD MILEAGE
of the
UNITED STATES
is being laid with
RAILS
made under

HUNT

Special H Inspection

Robert W. Hunt Co.
Engineers
2200 Insurance Exchange, Chicago

A. Plamondon

Electro-Mechanical Crossing Gate

The following features give an outstanding advantage to this gate

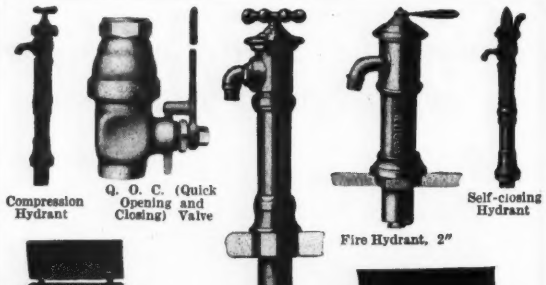
Operates Electro-Mechanically. A push button or remote automatic electric control will operate any number of units.

Speed—Starts, accelerates smoothly, and comes to an instant stop in four to four and one-half seconds.

Splendid workmanship and materials used thru out.

Write for complete description.

A. PLAMONDON—Division of
FOOTE BROS. GEAR & MACHINE CO.
225 N. Curtis St., CHICAGO, Ill.



THEY SAVE

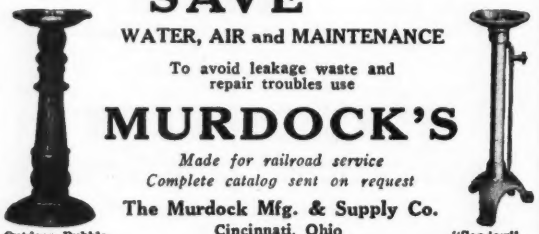
WATER, AIR and MAINTENANCE

To avoid leakage waste and repair troubles use

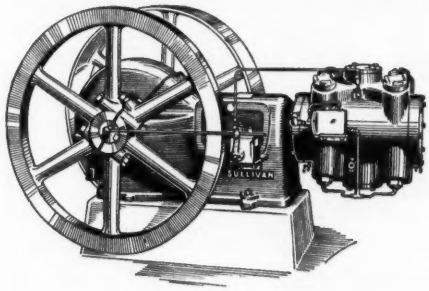
MURDOCK'S

Made for railroad service
Complete catalog sent on request

The Murdock Mfg. & Supply Co.
Cincinnati, Ohio
Since 1853



10 Features of the "WG-6" Mean Better Air Power Service



Ten important features enable the "WG-6" compressor to give you dependable, economical air power.

No Dust—Sure Lubrication
Main working parts are enclosed in a dust-tight housing and run in an oil bath. The cylinder is oiled by a reliable force-feed lubricator. Oil needs replenishing only at long intervals.

Wafer Valves
save power, and they are easy to get at and adjust.

"Sweep Control" Unloading Appliance
saves power by automatically interrupting compression whenever the desired pressure is reached; enabling the machine to run under no load until air is needed again.

7 Other Features
are described in the 16-page "WG-6" engineering catalog.

Write today for Catalog 1983-B

Sullivan Machinery Company
411 Peoples Gas Bldg., Chicago

Sent on approval for 5 days' FREE examination.

226 pages, 44 illustrations, cloth 6 x 9 inches, $3.50.

Your Best Bet

The thinking man never disregards the practical value of reading such books as "Roadway and Track." This book covers in a sentence facts that theorizing would stretch to a page.

This condensation has permitted the author to do what few have done previously—make the least demand upon the readers' time in giving him the meat of modern maintenance practice. Your best best is "Roadway and Track" if you want facts you can apply to your own work. You may keep this book for 5 days without cost.

Order today.

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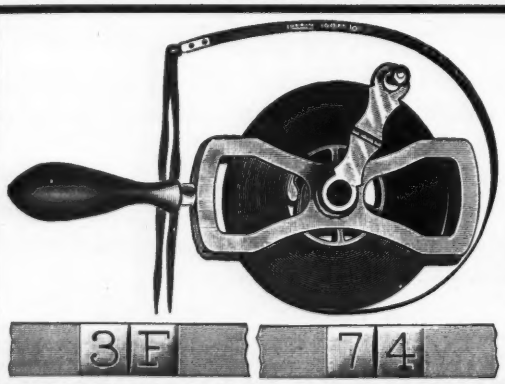

LUFKIN

"MICHIGAN" CHAIN TAPES

A sturdy Chain, 5/16" wide. Built for hard use, and most popular for rough survey. Half-gage mark when requested. Furnished measuring from end of chain, or with blank space, as specified.

Etched Chains and Engineers Tapes

Woven Tapes of All Descriptions

Send for Catalog

New York
Windsor, Canada
THE LUFKIN RULE CO.
SAGINAW, MICH.

ties
poles
bridge timbers

PRETTYMAN PRESERVED FOREST PRODUCTS P28

Grown in our forests, cut in our mills and creosoted in our complete and modern wood preserving plant to *your* specifications. May we quote you?

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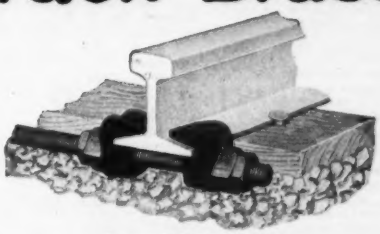
"Anchor" Track Braces



Patented Nov. 16, 1926

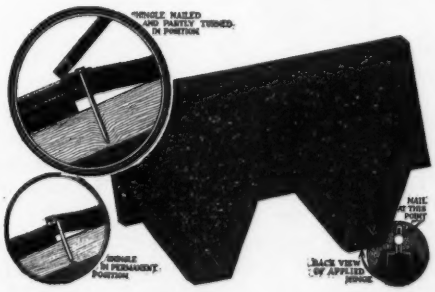
They hold the rail like in a vise. The lugs are self adjusting, so that one size brace fits on six different weights of rail.

Carry a few dozen track braces on every work train or wreck outfit. They are the quickest track repair that is possible. Send for full description.

Manufactured by

T. H. EDELBLUTE COMPANY
Wabash Building Pittsburgh, Pa
Also Manufacturers of "Anchor" Rerailers

This shingle *cannot blow up* because it's *locked down!*


SHINGLE NAILED AND PARTLY TURNED IN POSITION
NAIL AT THIS POINT
SHINGLE IN PERMANENT POSITION
BACK VIEW OF APPLIED SHINGLE

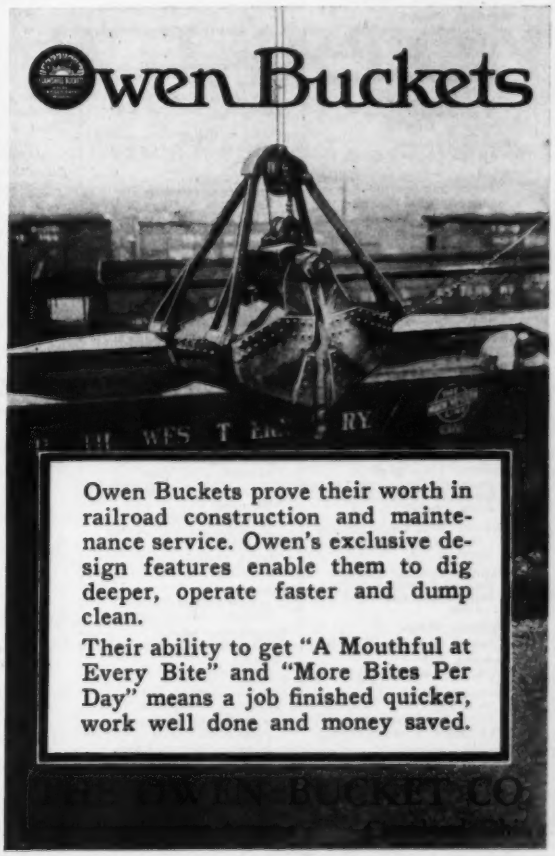
Locked down to the roof boards—held secure by a solid copper lock—the Mule-Hide *Storm-Safe* Shingle provides a roof that is wind resisting and water tight—*an all weather proof roof.*

Mule-Hide *Storm-Safe* Shingles have the greatest headlap of all asphalt shingles. For 6⅞ this headlap extends back upward on the roof defying inroad of the severest rain, sleet or snow storms.

Only 68 *Storm-Safe* Shingles required to cover 100 sq. feet roof surface. Write us for a sample of this practical shingle. Weight 210 lbs. Size 32x20⅛. Colors Green, Rainbow and Persian Blend.

ASPHALT ASBESTOS
THE LEHON COMPANY
MULE-HIDE ROOFS
West 44th to 45th Sts on Oakley Ave. Chicago, Illinois.

Owen Buckets



Owen Buckets prove their worth in railroad construction and maintenance service. Owen's exclusive design features enable them to dig deeper, operate faster and dump clean.

Their ability to get "A Mouthful at Every Bite" and "More Bites Per Day" means a job finished quicker, work well done and money saved.

Buyers' Guide

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Kalamazoo Railway Supply Co.
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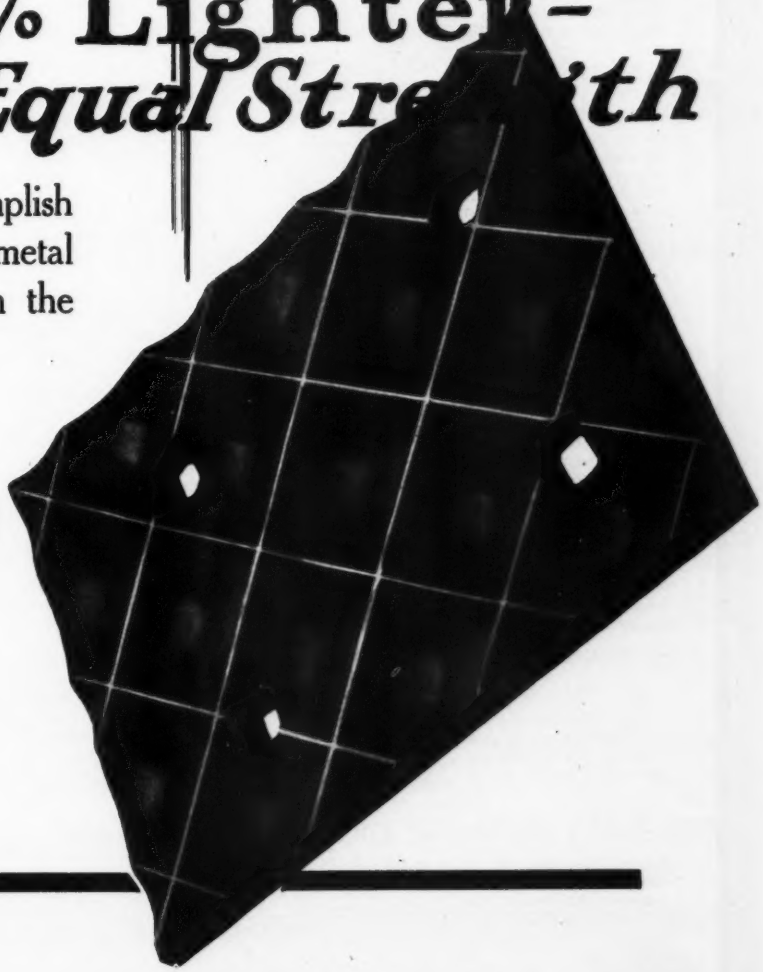

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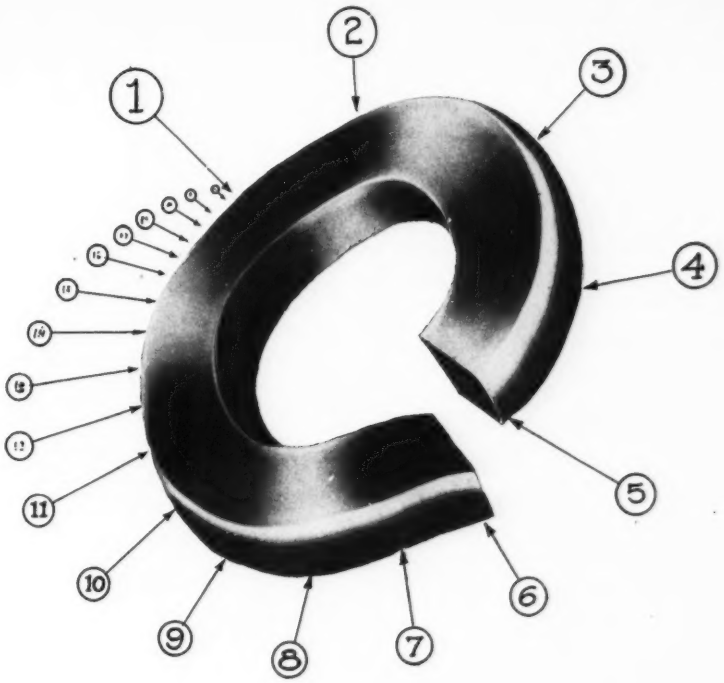

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Their adoption by the majority of this country's railroads is ample proof that their merits are in general well known, but in every railroad organization there are men interested in economy and efficiency to whom this proposed series of announcements will be addressed.

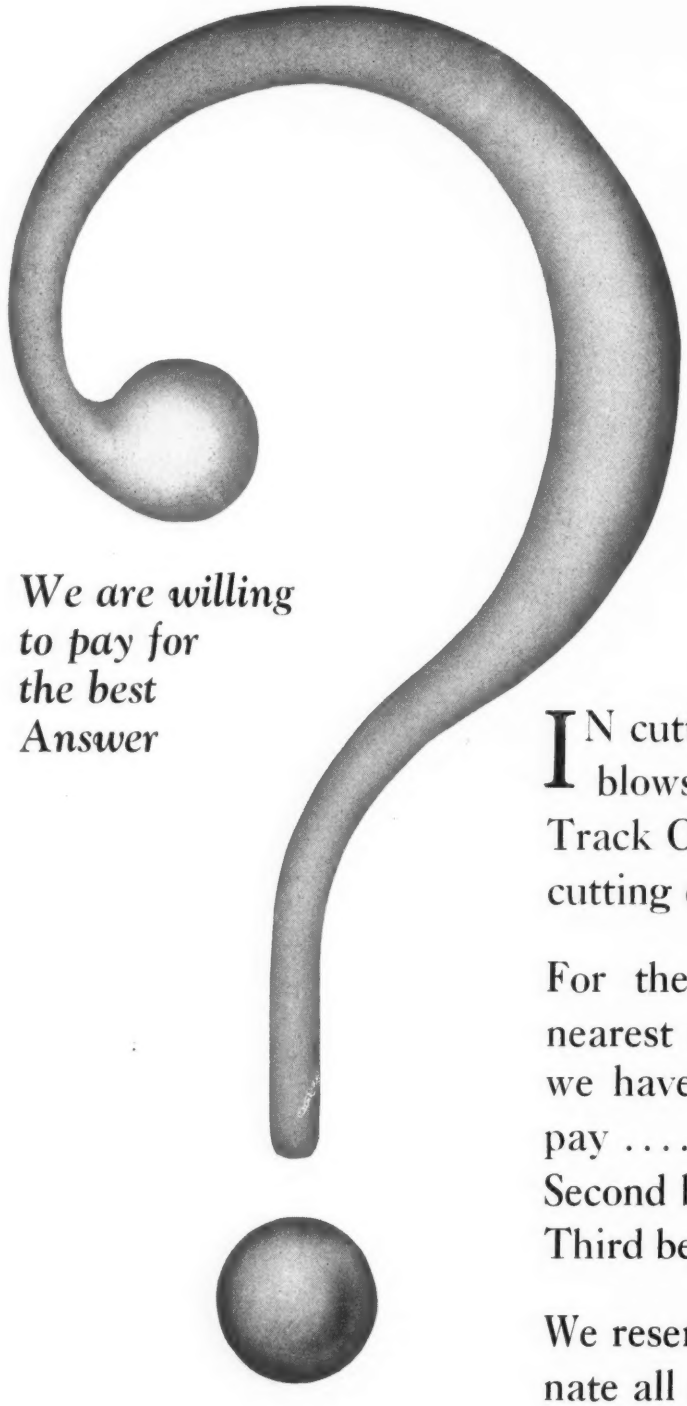
Anything that reduces operating expenses and helps to make the service better should be known to many others than the few who actually decide immediate purchases.

This publication is one of those selected to tell of the exclusive features of IMPROVED HIPOWER.

THE NATIONAL LOCK WASHER COMPANY
Newark, New Jersey, U. S. A.

IMPROVED HIPOWER

Commercially Non-flattenable - - Permanently Rust-Proof



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IN cutting a rail, how many blows should a Carbon Steel Track Chisel stand before the cutting edge gives way?

For the answer stating the nearest number of blows that we have determined, we will pay $60.00
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